Renewable energy assessment for Merthyr Tydfil County Borough Council

June 2017

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This report was produced for	Merthyr Tydfil County Borough Council
Issue date	June 2017
Version	Final version
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Executive summary

Renewable energy presents an opportunity for Merthyr Tydfil County Borough Council to reduce carbon emissions, generate income and retain energy spend. The area spends an estimated £90 million[1] on energy at present, the vast majority of which leaves the County Borough. Renewable energy that is generated and consumed in the area would help to retain a proportion of that spend locally.

To date, deployment of renewable energy in Merthyr Tydfil totals 11.2 MW of renewable electricity capacity and 0.7 MW of renewable heat capacity installed. Currently, this equates to around 4 per cent of energy demand from local generation.

This resource assessment found opportunities for the deployment of wind energy and ground-mounted solar energy across seven geographic areas. However, the topography of much of the area (a valley) means that most sites will be highly visible and so a supportive planning policy would be required if this resource is to be harnessed. The Council could consider identifying areas of search for local energy generation to enable this.

As a largely urban area, there is significant potential for rooftop PV on existing buildings. Small scale renewable heat technologies (heat pumps and biomass boilers) also have potential in the area, however, the majority of the area is on gas, meaning the financial case for renewable heat is weaker. The retrofit building integrated renewables market could be kick-started by public sector action – for example, through a programme of installations by housing associations, on Council properties and other public-sector building owners. Awareness raising actions could also support deployment in the area, for example through a local trade fair.

The heat assessment undertaken for this study found some potentially interesting district heat opportunities. For retrofit, heat networks involving the local hospital and schools demonstrate the strongest economic viability potential. New build opportunities related to the development areas of Project Heartland and Hoover/Dragonparc show greatest potential, with the viability for Goat Mill Road more difficult due to the site being split by the A4060 and variable anchor loads at the nearby industrial estate. Delivery of district heat in the area, through newbuild or as retrofit schemes could reduce carbon by up to around 4000 tonnes a year. Delivery of the retrofit opportunities will require the Council to coordinate and drive activity and in the case of the new build sites, strong planning policy will be needed to ensure these opportunities are fully explored and exploited where appropriate.

There are also opportunities for near site renewable energy at Goat Mill Road and Hoover/Dragonparc, and each of the sites could deliver renewable energy on site to offset at least 20 per cent of total carbon emissions through rooftop PV. The Council could consider introducing a policy to enable delivery of this onsite and near site opportunity. The report also identifies a number of other enabling actions for the Council to explore which would support the delivery of renewable energy in the area, including looking at taking part in smart energy trials.

[1] Based on BEIS sub-national energy consumption statistics (September 2016) and average energy cost figures

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1. Introduction

Renewable energy can bring a range of potential benefits to a local area, including economic and jobs growth, decarbonisation, income generation for the public sector, community groups and individuals, and wider social and community benefits. Merthyr Tydfil County Borough Council has the opportunity to facilitate appropriate renewable energy deployment in its area through evidence based planning policies and other supportive actions.

The Council commissioned Regen to undertake this assessment of the renewable energy opportunities in its area to inform the policies for its Local Development Plan. The assessment follows the task structure set out in the Welsh Government's document: Planning for Renewable and Low Carbon Energy - A Toolkit for Planners. However, for some tasks set out in the toolkit, we have used Regen's in-house tools and experience rather than following the toolkit processes, as these offer an updated and more robust or practical approach. The method followed is documented against each task.

This assessment aims to support the Council to develop its renewable energy and low carbon generation policies and actions. In accordance with the Planners' toolkit, evidence was gathered and analysed relating to the following policy options:

- P1 Develop area wide renewable energy targets
- P2 Inform site allocations
- P3 Identify opportunities and set targets for renewable energy on potential development areas
- P4 Identify opportunities and requirements for renewable or low carbon energy generation linked to new build potential development areas
- P5 Develop policy mechanisms to support District Heating Networks (DHNs) for new build potential development areas
- P6 Identify further actions for the local authority, public sector and wider stakeholders

2. Policy context and drivers for renewable energy

2.1 Devolved national planning context

Climate change is a devolved issue in Wales, although the approach taken is heavily influenced by UK and EU policy and legislation.

As a result of recent devolution processes, a significant number of legislative and policy changes in Wales, including the Planning (Wales) Act 2015[2], Energy Act (2016)[3], Wellbeing of Future Generations (Wales) Act 2015[4] and the Wales Bill 2016-2017[5] are impacting, and will continue to impact upon, how decisions on energy issues will be made in the future across Wales.

In addition, the Environment (Wales) Act[6] received Royal Assent in March 2016 and sets a 2050 target to reduce emissions by at least 80 per cent. It also provides the legislative framework for establishing a carbon budgeting approach in Wales. The Act requires that before the end of 2018, Welsh Ministers must set in regulation, interim emissions targets for 2020, 2030 and 2040, together with 5-year carbon budgets for the periods 2016-2020 and 2021-2025[7].

Welsh Government's planning policy is generally supportive of the need to deliver renewable energy to meet both the UK's 2020 European renewable energy target and decarbonisation objectives. The Minister for Natural Resources from 2013-2016, Carl Sargeant, wrote on a number of occasions to planning officers and Members urging local authorities to take a positive approach. For example, his letter from 15 March 2016 states:

> *Our planning policies in Planning Policy Wales (PPW) are clear that the planning system should support the transition to a low carbon society and that local planning authorities should facilitate the development of all forms of renewable and low carbon energy.*

In relation to onshore wind, the Welsh Government has taken a strategic approach, with TAN 8 clearly directing large wind developments (over 25 MW) to Strategic Search Areas. TAN 8 also serves to limit the proliferation of wind energy above 5 MW outside these areas and brownfield sites. However, the Minister's letter from 2015 encouraged authorities to use the Planning for Renewable and Low Carbon Energy toolkit to provide the evidence base to set policies that formulate allocations or areas of search for renewable energy or low carbon technologies for local authority scale renewables (5 to 25 MW wind and 5 to 50 MW solar). Allocating areas would help to unlock this scale of project in the area.

In June 2016, Cabinet Secretary Lesley Griffiths continued this call to local authorities to take positive action to drive forward changes to the planning system, including making it both visionary and

[2] http://gov.wales/topics/planning/legislation/planning-wales-act-2015/?lang=en
[3] http://services.parliament.uk/bills/2015-16/energy.html
[4] http://gov.wales/topics/people-and-communities/people/future-generations-act/?lang=en
[5] http://services.parliament.uk/bills/2016-17/wales.html
[6] http://www.legislation.gov.uk/anaw/2016/3/enacted
[7] https://www.theccc.org.uk/2016/12/16/call-for-evidence-welsh-carbon-budgets/

evidence based, highlighting that 'if we want a more sustainable Wales we all need to recognise the value of planning, including the economic value that it creates'[8].

There is also strong government support for community energy projects and encouragement for local authorities to facilitate the progress of community energy projects through the planning system with pre-application support.

In addition, the Welsh Government has set Building Regulations for new development that are 8 per cent more efficient than the Part L of Schedule 1 of the Building Regulations 2010 standard. The Welsh Government has the authority to tighten these further, and the National Assembly for Wales in its document 'A Smarter Energy Future for Wales' called for these to be "urgently revised to ensure that all new houses are built to near zero energy standards." The Government's position on this is currently unclear; a review took place in 2016. The Welsh government is also considering extending permitted development rights for non-domestic properties to install solar panels, with research on this commissioned in 2016. However, local authorities in Wales can still set higher than Building Regulations energy/carbon standards for strategic new developments[9], a power that has been removed from their English counterparts.

2.2 Changes to subsidy regimes

Despite a generally supportive planning context, renewable energy in Wales, as across the UK, is currently being affected by changes to the subsidy regime controlled in Westminster through the Levy Control Framework. It is not expected that Wales will establish its own Levy Control Framework and therefore Welsh projects will continue to face the challenges of developing alternative business models, developing more efficient schemes or identifying alternative financing mechanisms.

2015 and 2016 were a turbulent time for renewable energy, with:

- major reductions to the Feed-in Tariff for all scales
- the early closure of the Renewables Obligation for wind and large scale PV
- changes to the terms of Contracts for Difference (CFD) meaning that CFDs will not support onshore solar or wind projects
- changes made to the Renewable Heat Incentive reducing the level of support available for some heat technologies
- proposed changes to embedded benefits.

However, Regen's assessment is that renewable energy deployment across the UK is likely to continue to see strong growth over the next decade, with a number of drivers having an impact.

[8] http://www.rtpi.org.uk/media/1842034/cabinet_secretary_for_environment_and_rural_affairs.pdf
[9] http://www.legislation.gov.uk/ukpga/2008/21/section/1

2.3 Growth drivers of renewable energy

2.3.1 The need to meet long-term carbon targets

There are a number of medium and long term drivers to decarbonise energy supplies in the UK and Wales.

- The UK is commited to producing 15 per cent of its total energy consumption from renewable energy by 2020 under the EU Renewable Energy Directive – a target which is still in place in early 2017.
- The Climate Change Act 2008 commits the UK to at least an eighty per cent reduction in greenhouse gas emissions by 2050. This is being implemented through a series of UK carbon budgets. In 2016, government enacted the fifth carbon budget which sets targets to 2032. The UK has demonstrated a strong track record in meeting the first, second and third carbon budget targets, predominantly through the deployment of wind and solar power, the closure of coal generation in the power sector and deindustrialisation. However, the UK government has acknowledged we are not on track to meet the forth carbon budget or the target of a 57 per cent reduction in carbon emissions by 2032 set in the fifth carbon budget.
- It is expected that the new Emissions Reduction Plan due to be published by the UK Government in 2017 will address this issue and also consider our obligations under the Paris Agreement. The current carbon budget targets are derived as a contribution to a global path aimed at keeping global average temperature rise to around 2^{o}C on the lowest cost path to 2050. However, to achieve a carbon budget commensurate with the Paris Agreement's objectives of keeping global warming within 1.5 degrees and taking a fair share of the global carbon budget, it is recognised that this requires strengthening and potentially overachieving on current efforts towards 2 degrees.
- The Environment (Wales) Act (2016) established a target for Wales to reduce its emissions by at least 80 per cent from 1990 levels by 2050, with 5-year carbon budgets due to be established.

This legal framework to deliver reductions in carbon emissions is highly likely to require a continued commitment towards renewable energy growth over the medium term.

2.3.2 Falling technology prices and grid parity

Globally, investment in renewables also now outstrips that in fossil fuels and the gap is widening. 2015 was a record year for renewables, with the highest ever level of investment into new build renewable energy generation at $293 billion and the highest ever installation levels, with 64 GW of wind and 57 GW of solar PV commissioned during the year, an increase of nearly 30% over 2014[10]. 2016 saw reduced investment, but this was in part due to sharp falls in equipment prices resulting from economies of scales in deployment, particularly in solar PV.

[10] http://about.bnef.com/press-releases/clean-energy-defies-fossil-fuel-price-crash-to-attract-record-329bn-global-investment-in-2015/

Bloomberg New Energy Finance predict that, that regardless of national policies, the renewables market has gained critical mass and will continue to develop.

The global market growth means that technology prices are falling rapidly, particularly for solar PV and wind. Onshore wind can now provide the cheapest electricity available. Good Energy have proposed the first subsidy free wind farm at their Big Field site in Cornwall. If the site is successful (at appeal), it would mean that grid parity has been achieved for onshore wind (given the right site conditions).[11] Grid parity is expected to be achieved in the medium term for large scale solar PV, with other technologies and scales following. The achievement of grid parity means that decisions about investing in renewables will no longer be based on the availability of a government subsidy, leading to more stable growth in deployment levels.

The UK government's Department for Business, Energy and Industrial Strategy (BEIS) 2016 report on the Levelised Cost of Energy (LCOE), puts new onshore wind and large scale solar projects commissioning in 2025 at a lower cost per MWh than the next generation of Combined Cycle Gas Turbine (CCGT) projects.

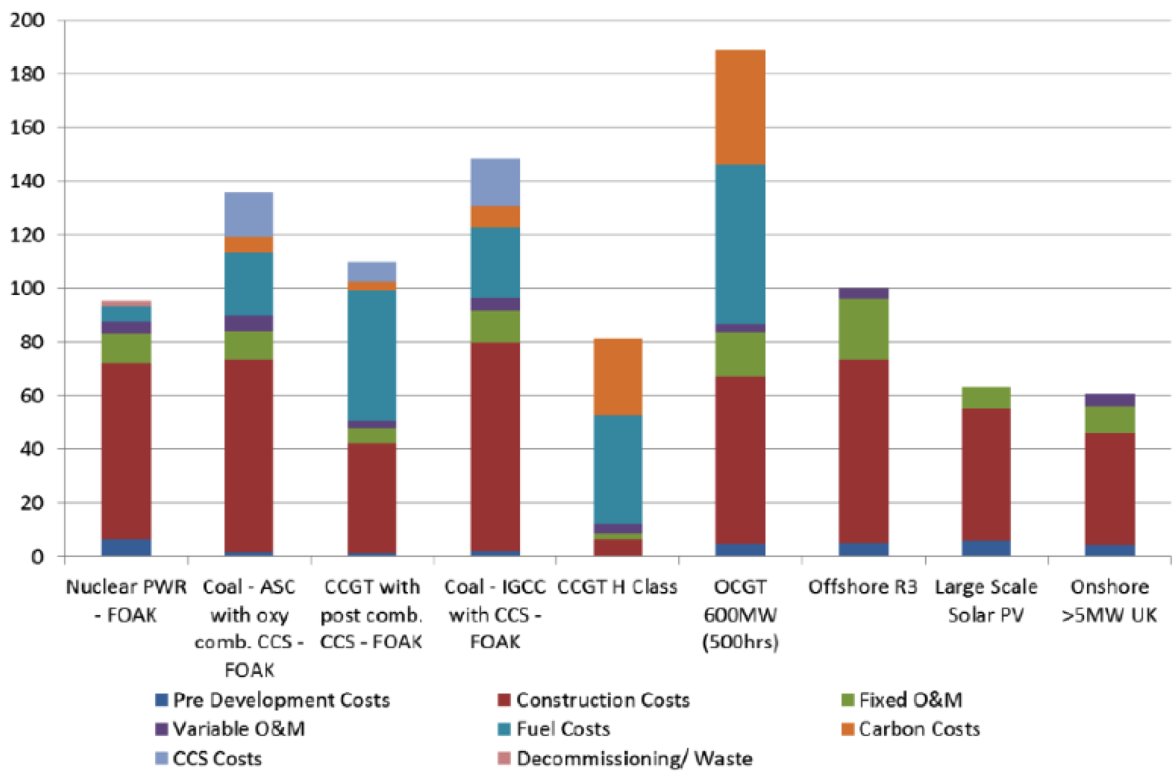

Figure 1: BEIS's 2016 LCOE
Levelised cost estimates for projects commissioning in 2025, technology-specific hurdle rates, £/MWh

[11] The term "grid parity" describes the point in time, at which a developing technology will produce electricity for the same cost to taxpayers as conventional technologies.

2.3.3 Flexibility and smart power unlocking grid constraints

As a result of widespread deployment of distributed renewable energy, grid constraints are increasingly becoming an issue, with some areas unable to connect further generation projects without prohibitively expensive upgrades. Ofgem is taking steps to enable Distribution Network Operators to play a more proactive role in managing their networks, transitioning towards becoming Distribution System Operators. In preparation for this role, Western Power Distribution, the Distribution Network Operator for Merthyr Tydfil (and the rest of south Wales) is producing an investment strategy to address the potential impacts that further renewable energy growth will have on their network, based on growth scenarios prepared by Regen. Their investment plans might include alternative approaches to network connections and flexible approaches to network management, as well as investment in strategic upgrades (see section16.6 for more information).

The UK government has recognised the role that smart power – principally through interconnection, storage and demand flexibility – has to play in enabling the decarbonisation of our energy system. For example, the National Infrastructure Commission's Smart Power report sets out how smart power could save consumers up to £8 billion a year by 2030, help the UK meet its 2050 carbon targets, and secure the UK's energy supply for generations. As a result there is significant industry focus on the role that flexibility and storage can play in managing the grid and addressing grid constraint issues, as well as improving the business case of energy projects facing constrained connections. Ofgem reports there are 20 GW of applications to connect storage to the network. The development of storage at this scale, alongside flexibility in demand, would address many of the barriers to greater renewable energy deployment.

2.4 The need for policy and supportive actions to drive deployment in Merthyr Tydfil

Due to the devolved nature of Climate Change policy, Wales, and therefore Merthyr Tydfil, have the opportunity to develop supportive policies which will attract renewable energy investment into the area, and as time goes on, the pressure to take conserted action to reduce carbon emissions will only increase.

This report sets out the current baseline and potential resource availability based on the Practice guidance: Planning for renewable and low carbon energy – a toolkit for planners and concludes that Merthyr Tydfil has a modest, but valuable, portfolio of renewable energy resources which could be harnessed. Details of these can be found in the subsequent sections of this report. These resources offer the potential for income generation and energy spend retention in the local area and we have used this evidence as a basis to recommend that proactive policies are put in place to ensure that the resources are protected and harnessed in a way that will most benefit the local area and the local people.

3. E1 Task 1: Calculate existing and future energy baseline

3.1 Method

We have calculated energy demand in Merthyr Tydfil using the sub-national energy consumption statistics from BEIS. The most up to date figures released in September 2016, cover the period from 2003 to 2014.

Using National Grid's Future Energy Scenarios[12] (FES) as a basis, we then projected energy demand for electricity, heat and transport up to 2031 under four different scenarios. The following graphic is reproduced from National Grid's FES to illustrate the scenarios that we have based the assessment on.

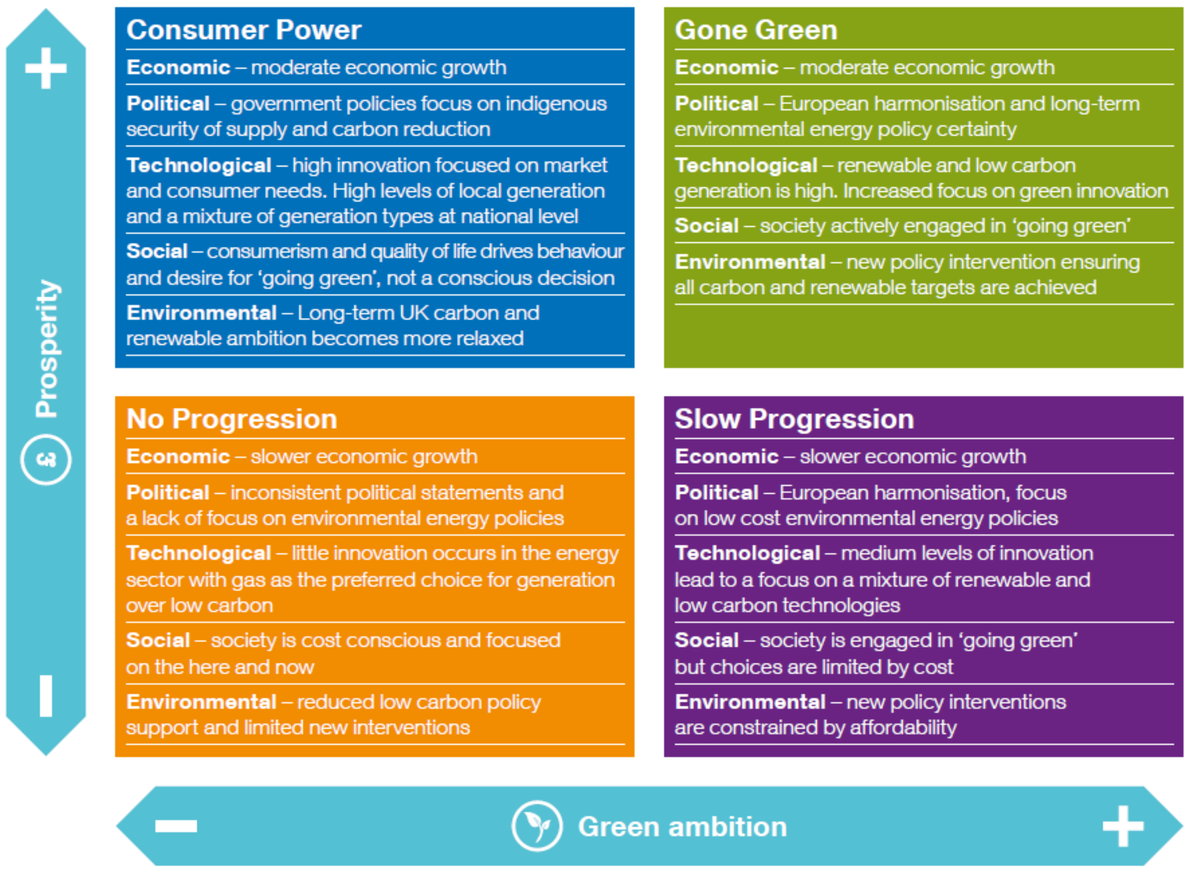

Figure 2: National Grid Future Energy Scenarios

The scenarios have been created against two axes; economic growth and green ambition. Below is our summary interpretation of the scenarios:

- Under the Gone Green scenario, it is assumed that future governments take a strategic policy approach to the energy system, consistent with the decarbonisation targets set for 2030 and 2050, and reinforced by the commitments made under the Paris Agreement. It is assumed that market conditions, financial support and technology development is conducive to the

12 http://fes.nationalgrid.com/fes-document/

strategic growth of distributed generation, allied to the growth of electricity storage solutions and electricity demand technologies, such as electric vehicles and heat pumps. As a result, overall growth of low carbon technologies is strongest under this scenario.

- The Consumer Power scenario is driven more by the market and has features that lead to an emphasis on deployment of smaller scale generation and local supply through individuals, communities and other organisations, including technology development and consumers interested in green technologies. Government intervention is more limited under this scenario, with policies supporting deployment where there is demand for it from consumers and communities. The result is widespread, dispersed growth of small and medium scale renewable technologies.

- The Slow Progression scenario features a strategic approach to renewable energy by government, but in a poor economic environment, which means there is a less government budget for support, less investment capital available and fewer technological innovations. Government policy is focused on the lowest cost actions, unlocking regulation and barriers where it is cost-effective to do so. The result is a medium growth scenario, with a focus on the lowest cost technologies.

- Under the No Progression scenario, there is a continued dependence on fossil fuels that would not be consistent with the UK's stated decarbonisation and climate change commitments. The poor economic climate is coupled with a lack of green ambition across society. Growth of distributed generation is therefore slow for all scales and technologies under this scenario.

3.2 Results

3.2.1 Existing energy use

The following table and figure shows existing energy use in Merthyr Tydfil. Overall, energy demand has been declining in recent years, partly due to improvements in energy efficiency and the growth of less energy intensive service sectors.

Table 1: Existing energy use by fuel source[13]

Energy use	Type	GWh
Coal	Industrial & Commercial	2.37
	Domestic	7.55
	Rail	0.12
	Total	*10.04*
Manufactured fuels	Industrial	
	Domestic	0.86
	Total	*0.86*
Petroleum products	Industrial & Commercial	33.04
	Domestic	9.11
	Road transport	309.42
	Rail	10.82
	Total	*362.39*
Gas	Industrial & Commercial	123.80
	Domestic	356.79
	Total	*480.59*
Electricity	Industrial & Commercial	139.24
	Domestic	88.21
	Total	*227.45*
Bioenergy & wastes	*Total*	*47.44*
All fuels	*Total*	*1128.76*

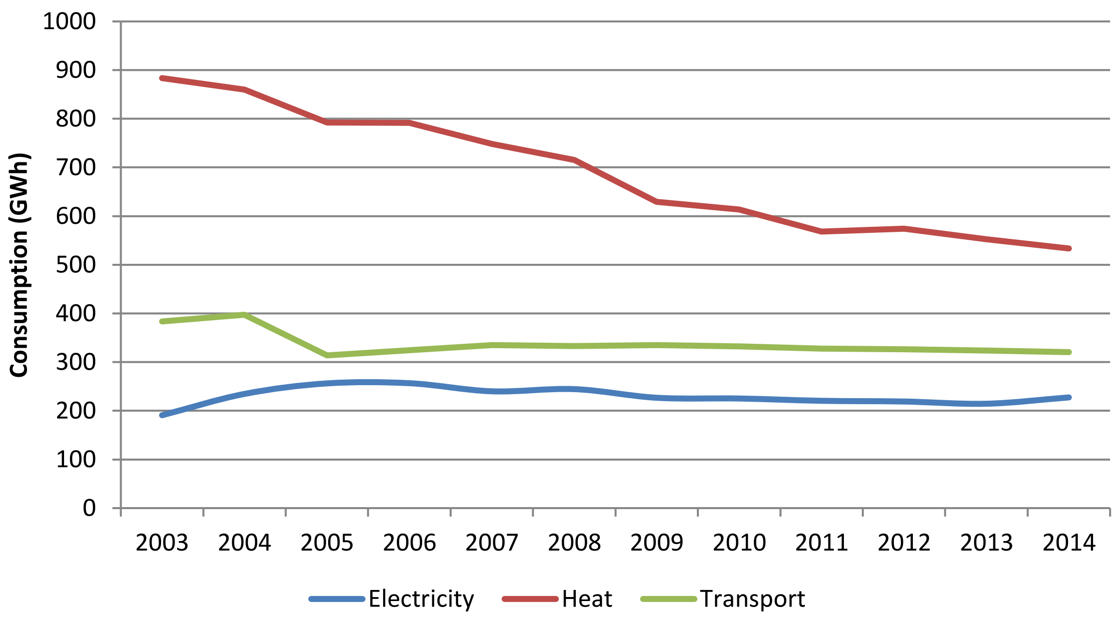

Figure 3: Existing energy use by type in Merthyr Tydfil

[13] BEIS Total sub-national final energy consumption (September 2016)

3.2.2 Population growth scenarios

Table 2 from MTCBC shows the expected growth in total population and housing in the local authority under a range of scenarios.

The population of Merthyr Tydfil reached 59,810 in June 2016[14]. The Council does not anticipate major growth in overall population up to 2031. The dwelling led scenario (Scenario 3) predicts the highest level of growth of around 9,400 people.

MTCBC anticipate the Scenario 2: Dwelling led scenario (past 15-year build rate), shown in table 2 with an annual build out rate of 150 dwellings per annum to be the most suitable figure for the area. We have taken the annual figure for Scenario 2 and factored this into the energy demand growth scenarios. The gone green and consumer power scenarios use this figure, whilst the lower economic scenarios of slow progression and no progression use lower annual build figures.

Table 2: Scenario growth for population and housing up to 2031[15]

Scenario	Population to 2031	Dwelling requirement 2016-2031	Dwelling requirement per annum
Scenario 1: Welsh Government Principal Projection	59,011	330	22
Scenario 2: Dwelling led scenario (past 15 year build rate	64,394	2250	150
Scenario 3: Dwelling led scenario (meeting current LDP requirement)	68,742	3795	253

For this assessment three areas with potential for housing growth have been considered:

- Project Heartland – around 440 dwellings
- Hoover factory/Dragonparc – 800 dwellings
- Goat Mill Road – 400 dwellings

These potential development areas are still in the initial stages of the Local Development Plan process, therefore the details provided by the Council are approximate values.

[14] StatsWales, Population estimates by local authority and year
[15] Merthyr Tydfil County Borough Council Planning Office

3.2.3 Demand growth predictions

Electricity demand

For electricity demand, Figure 4 shows an increase in 2014. This appears to be an anomaly; overall our predictions anticipate the continuation of a downward trend in the short-term.

Post 2025, this decline is offset in the higher economic scenarios (Gone Green and Consumer Power) as a more affluent; consumerist society develops with a greater demand for new power-using products. These scenarios predict significant growth in the electric vehicle market. Alongside this, more houses will be built in the higher economic scenarios, and the uptake of heat pumps in new build will further increase overall demand. Slow Progression sees the lowest electricity demand with low economic growth coupled with environmental awareness from consumers, resulting in energy efficiency investments and behavioural change.

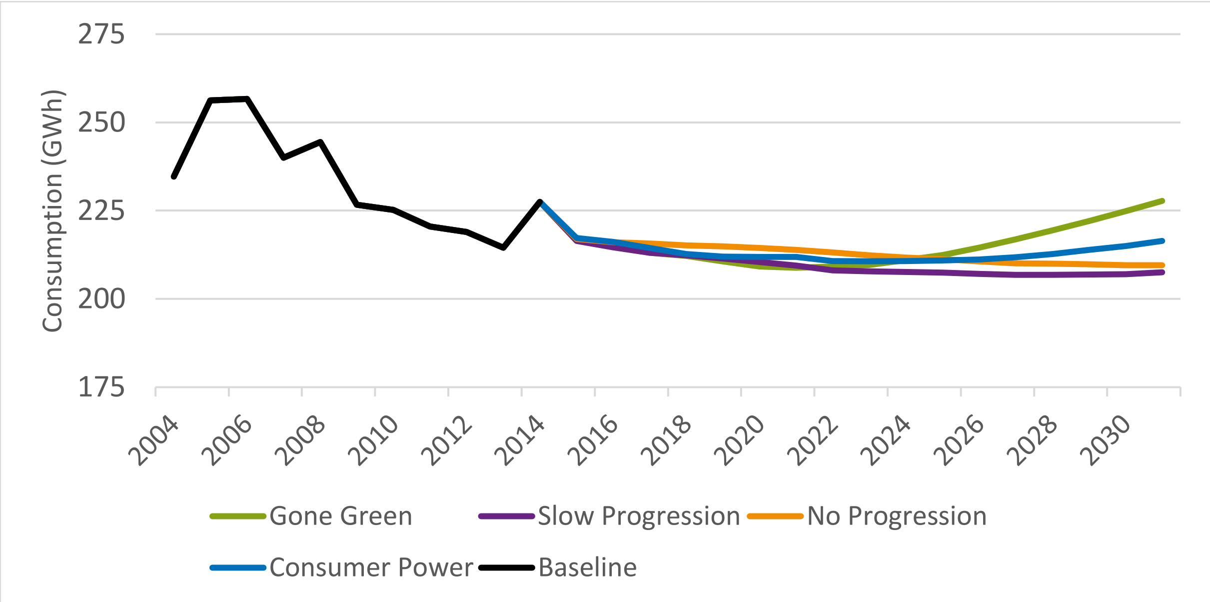

Figure 4: Growth in electricity demand up to 2031

Heat demand

Heat demand is predicted to decrease in the scenarios with greater green ambition (Gone Green and Slow Progression) as more energy efficiency measures are installed and new homes are built with higher energy standards. Under No Progression and Consumer Power, the predicted decrease in heat demand is more marginal. This reflects the current situation in which uptake of energy efficiency measures across the UK has been limited.

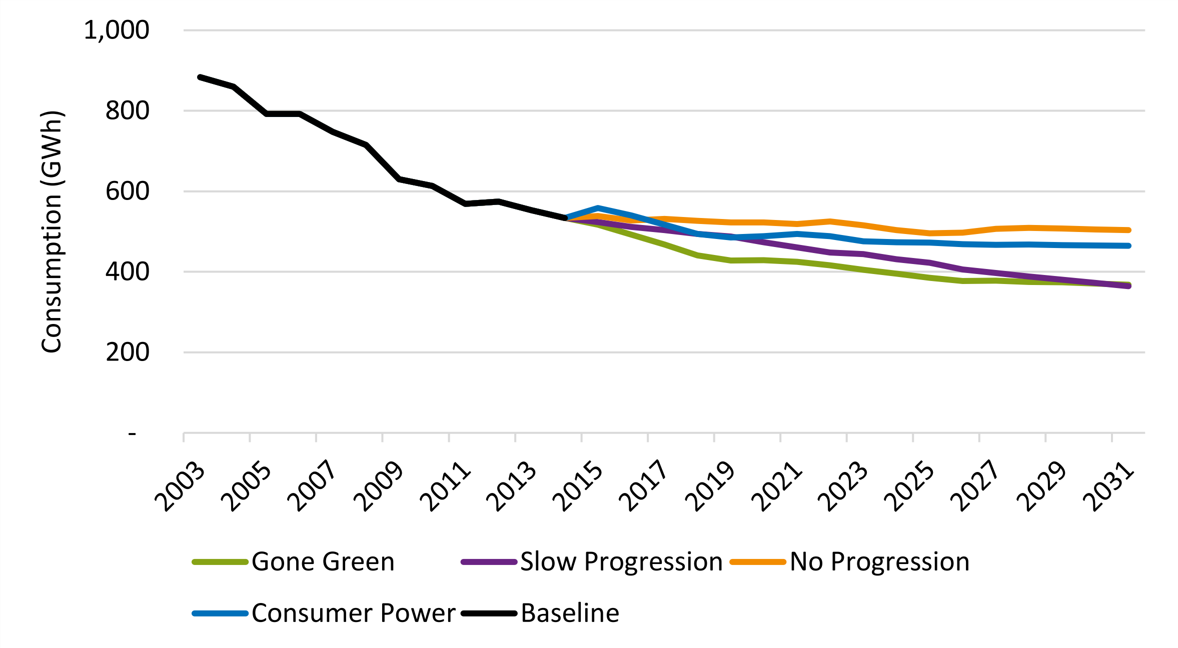

Figure 5: Growth in heat demand up to 2031

Transport demand

Energy demand for transportation would be expected to plateau under the Consumer Power and No Progression scenarios due to a lack of alternative options resulting in less behavioral change. Whilst the scenarios with greater green ambition see a more significant reduction in demand, as there is increased public investment in low carbon and public transport including initiatives such as the South Wales Metro and Cardiff Capital Region City deal, a more conscientious general public are likely to use public transport more frequently and reduce their overall transport use. The number of new electric vehicles varies under each scenario, with higher growth in the gone green and consumer power scenarios; the increased electricity use is captured in the scenarios for electricity demand above, with a corresponding decrease in conventional vehicle use in the transport scenarios.

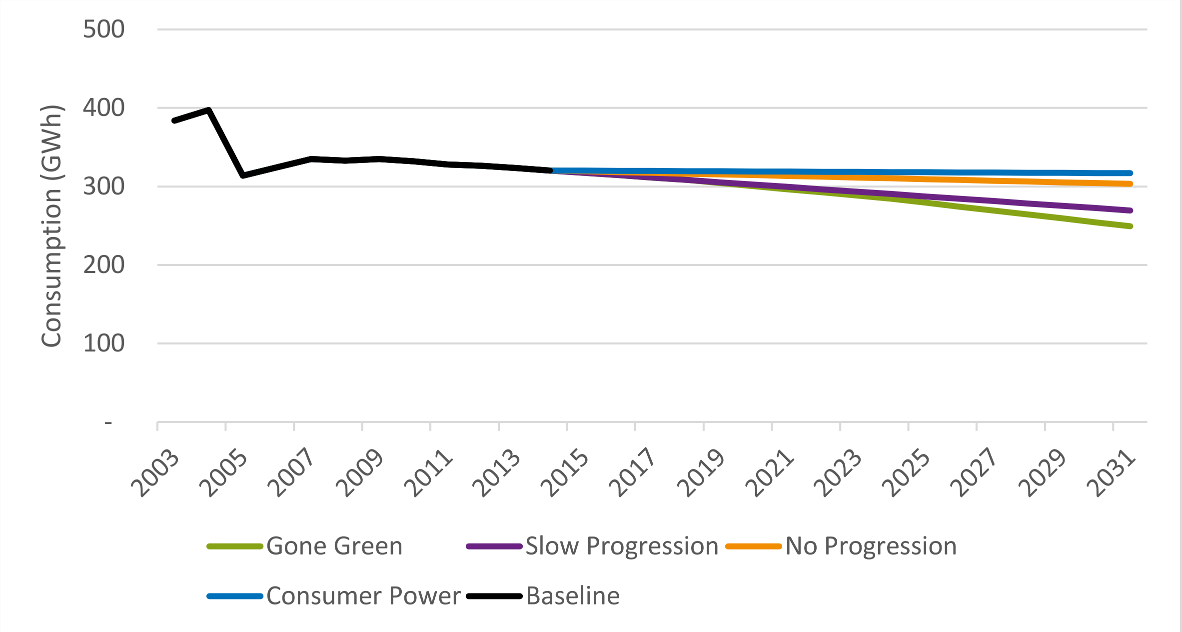

Figure 6: Growth in transport energy use in Merthyr Tydfil

If you combine these trends in electricity, heat and transport demand, even with significant progress in energy efficiency, overall energy use in Merthyr Tydfil would be expected to plateau over time, demonstrating the clear need to address the carbon impact of servicing the remaining demand of the area.

4 E1 Task 2: Existing and proposed low and zero carbon energy technologies

The initial task was to identify the existing and proposed low and zero carbon projects (LZC) which would then feed in to our future projections and technology assessments to understand where existing resource is being utilised.

4.1 Method

To locate existing low and zero carbon projects within Merthyr Tydfil we have used the following sources to verify project data:

- Ofgem FIT installation report (December 2016)
- Renewables Obligation register
- Renewable Heat Incentive freedom of information request (FOI)
- Regen Progress Report 2016 data
- Primary data collection – speaking to utilities and developers

To see a more detailed listing of operational projects we have provided the Council with a LZC database, which lists sites commissioned up to December 2016 using the most recent version of the publicly available datasets and our own data collection.

For pipeline projects, we have used the BEIS Renewable Energy Planning Database, which covers projects over 1 MW. Alongside this, we have used the MTCBC planning portal and contact with key organisations, such as Welsh Water, to identify any proposed projects that have planning approval and are yet to be built or are currently under construction.

4.2 Results

The following section shows existing and planned projects in Merthyr Tydfil by technology. Table 3 lists the operational projects in Merthyr Tydfil by technology.

Table 3: Project totals by technology

Technology	Number of projects	Elec Capacity (MWe)	Heat Capacity (MWth)	Electricity Generation (MWh)	Heat Generation (MWh)
Biomass	7	1	0.42	6,142	1,279
Heat pump	11		0.22		440
Hydropower	1	0.10		480	
Landfill gas	2	6.20		23,355	
Onshore wind	4	1.50		3,508	
Solar PV	614	2.38		2,629	
Solar thermal	16		0.03		20
Total	**655**	**11.18**	**0.67**	**36,114**	**1,738**

Due to the level of detail available from certain datasets, such as the FIT installation report and RHI FOI, it is not possible to gather exact location information, such as a postcode or grid reference for every project. The installations from the FIT report have been aggregated by Lower Super Output Areas (LSOA), and the capacity figures are shown in the thematic maps below. RHI details are only given to a local authority level; therefore, such projects cannot be mapped. Figure 7 below shows the existing renewable energy projects with exact location details provided.

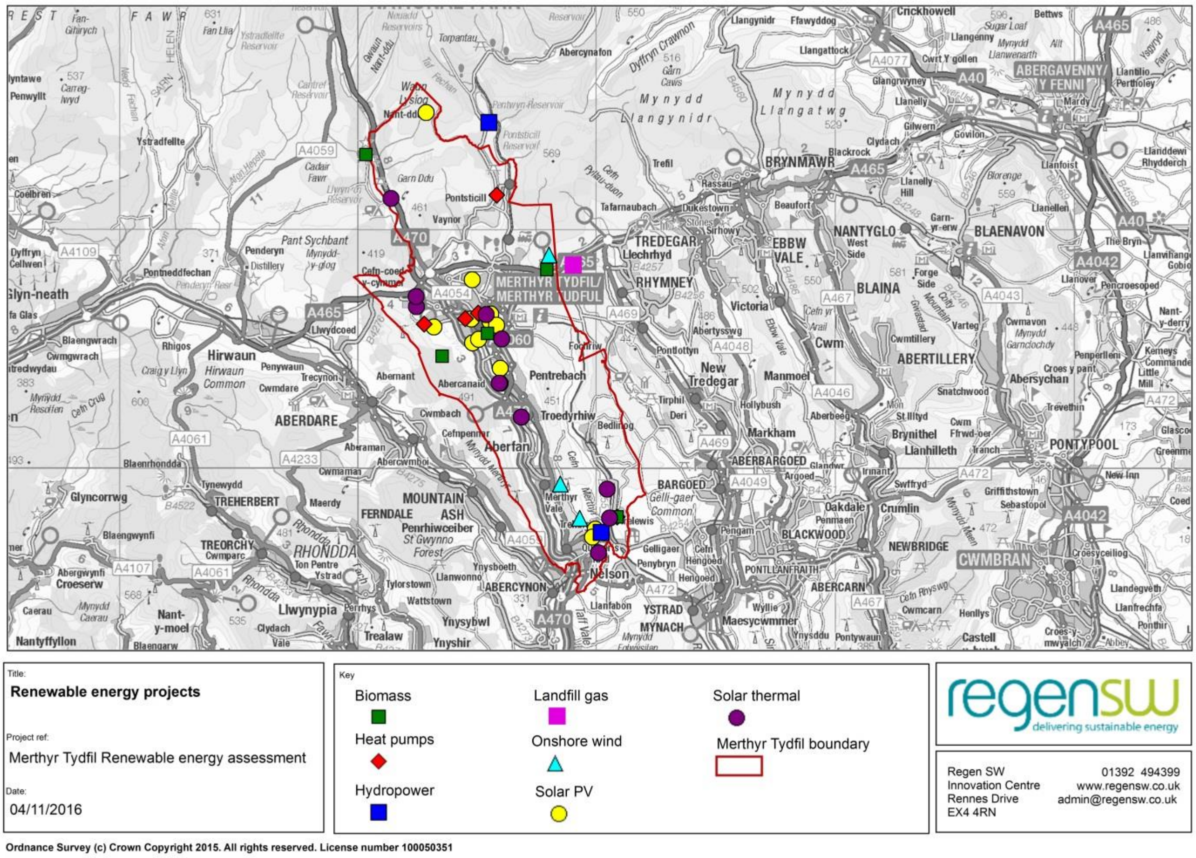

Figure 7: Existing renewable energy projects in the Merthyr Tydfil area

4.3 Biomass

Biomass deployment in the area is low. This is consistent with installation patterns across the country; deployment tends to be low in areas like Merthyr Tydfil which generally have access to gas. A summary of project details and their geographical spread can be seen below.

Table 4: Details on existing biomass projects

Number of projects	Installed capacity		Generation	Ownership		
	Electricity (MWe)	Heat (MWth)	MWh	Commercial	Domestic	Public sector
7	1	0.417	7,420	4	2	1

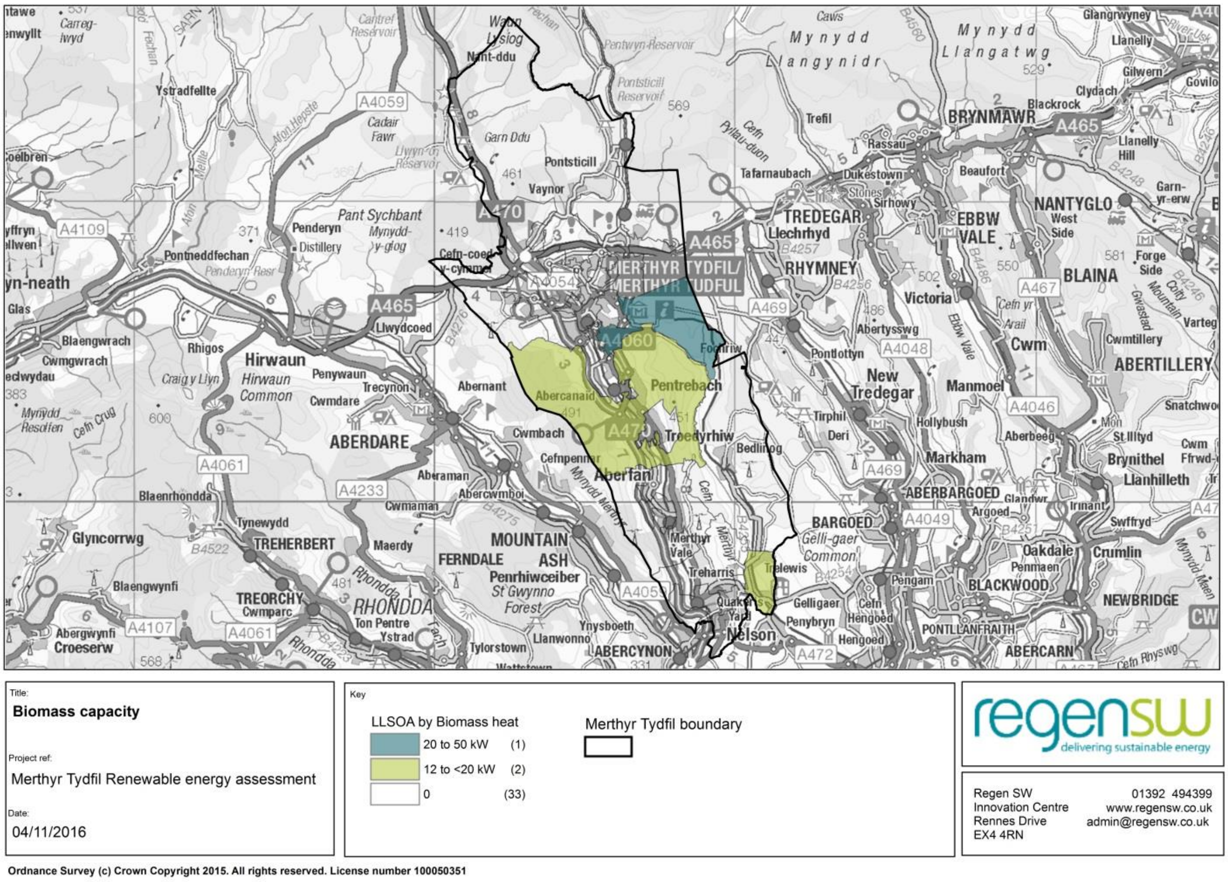

Figure 8: Installed biomass heat capacity across Merthyr Tydfil

4.4 Heat pumps

There has been significant growth in the deployment of heat pumps in domestic installations across the UK due to the domestic Renewable Heat Incentive. However, similar to biomass, the areas with highest deployment tend to be off-gas, therefore current installation figures in Merthyr Tydfil remain relatively low as can be seen below.

Table 5: Details on existing heat pump projects

Number of projects	Installed capacity	Generation	Ownership		
	Heat (MWth)	MWh	Commercial	Domestic	Public sector
11	0.218	440	1	9	1

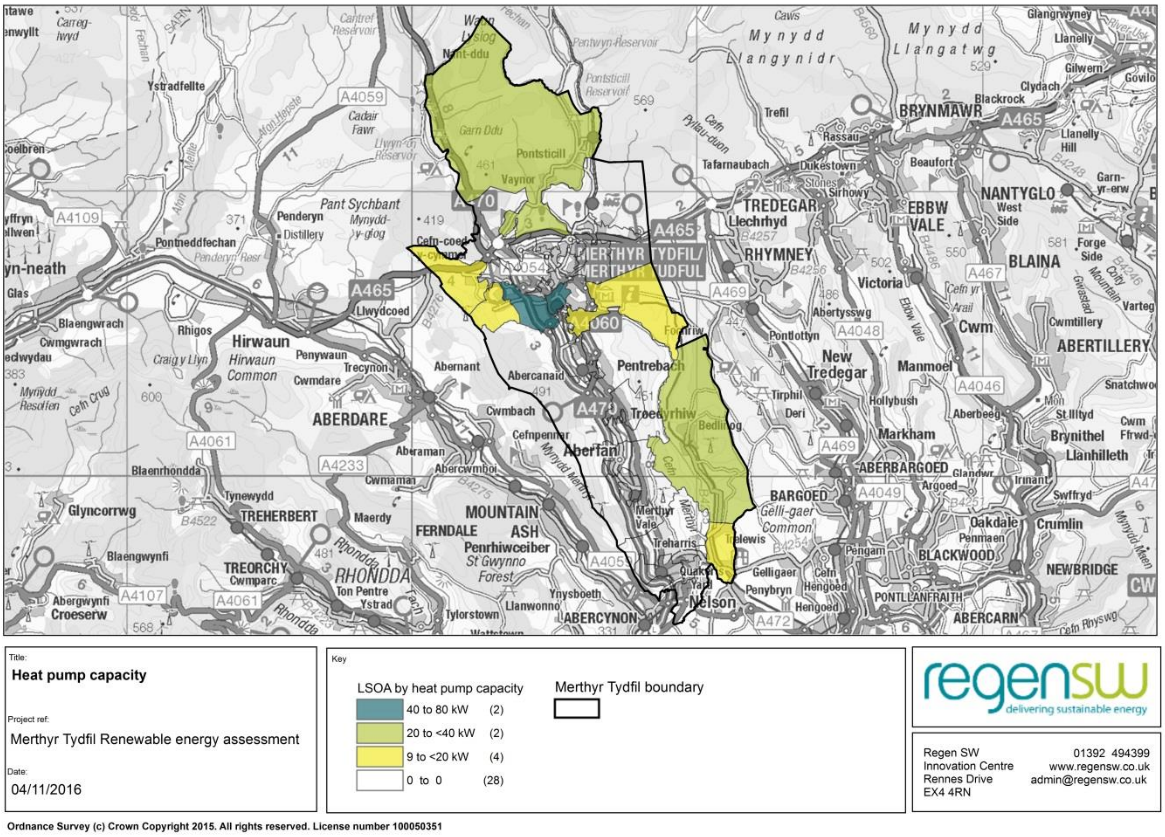

Figure 9: Installed heat pump capacity across Merthyr Tydfil

4.5 Hydropower

The one operational hydropower site in Merthyr Tydfil is the 100 kW Taff Bargoed Park project, which is situated in Parc Taf Bargoed and is run by the Friends of Taff Bargoed Park Group. The scheme generates 480MWh of energy per year and the income produced will be invested back into the park to improve the facilities, support a park warden and make environmental improvements for the benefit the whole community.

Table 6: Details on existing hydropower projects

Number of projects	Installed capacity	Generation	Ownership
	Electricity (MWe)	MWh	Community
1	0.1	480	1

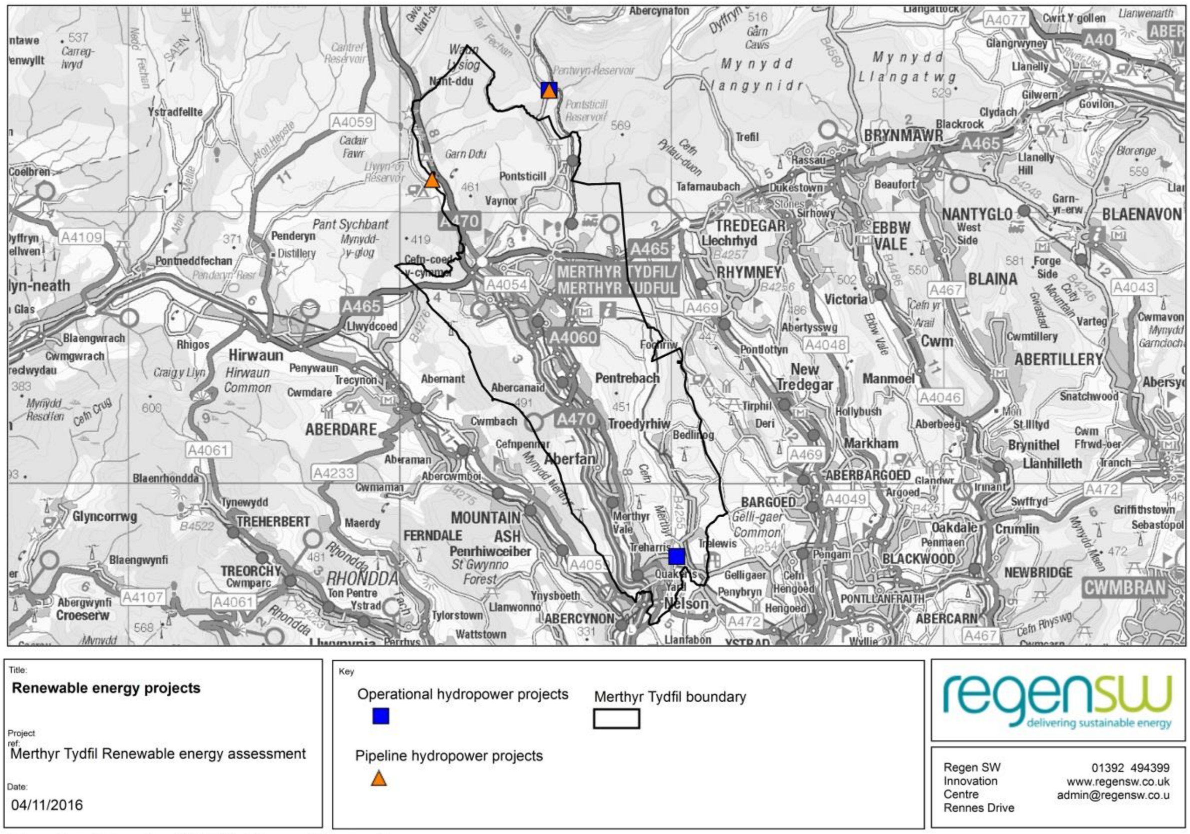

Figure 10: Hydropower project in Merthyr Tydfil

The Llwyn Onn WTW is the only Welsh Water site within the County Borough boundary. Currently Welsh Water are constructing a 100kW turbine on the compensation flow from the reservoir to the river. This project will be due for commissioning by 1 June 2017. Pontsticill WTW has a 375kW hydropower project and Welsh Water is also developing a second hydropower project at Pontsticill reservoir, an 88kW compensation turbine. However, both Pontsticill projects are just within Powys local authority area.

4.6 Landfill gas

Trecatti landfill site has been operational since 2002. The site capacity was increased in 2006 with an additional 5MW added. The limitation with this technology is the gradual depreciation and unpredictable nature of landfill gas output, which has a subsequent impact on capacity potential (approximately 5 per cent reduction annually). Currently, this site contributes 55 per cent to the total installed capacity across Merthyr Tydfil. The shift away from landfill for waste management towards recycling and energy from waste facilities means that there is no potential for new landfill gas projects.

Table 7: Details on existing landfill gas projects

Number of projects	Installed capacity	Generation	Ownership
	Electricity (MWe)	MWh	Commercial
1	6.2	23,354	1

4.7 Onshore wind

To date, 3 commercial wind turbines have been built. These are 500 kW each. One micro domestic turbine has also been built.

Table 8: Details on existing onshore wind projects

Number of projects	Installed capacity	Generation	Ownership	
	Electricity (MWe)	MWh	Commercial	Domestic
4	1.5036	3,508	3	1

The first turbine at Pengarnddu Industrial Estate was commissioned in 2013, with the two sites in the south commissioned in 2014. An additional 230kW turbine has been granted planning permission on the Pengarnddu Industrial Estate.

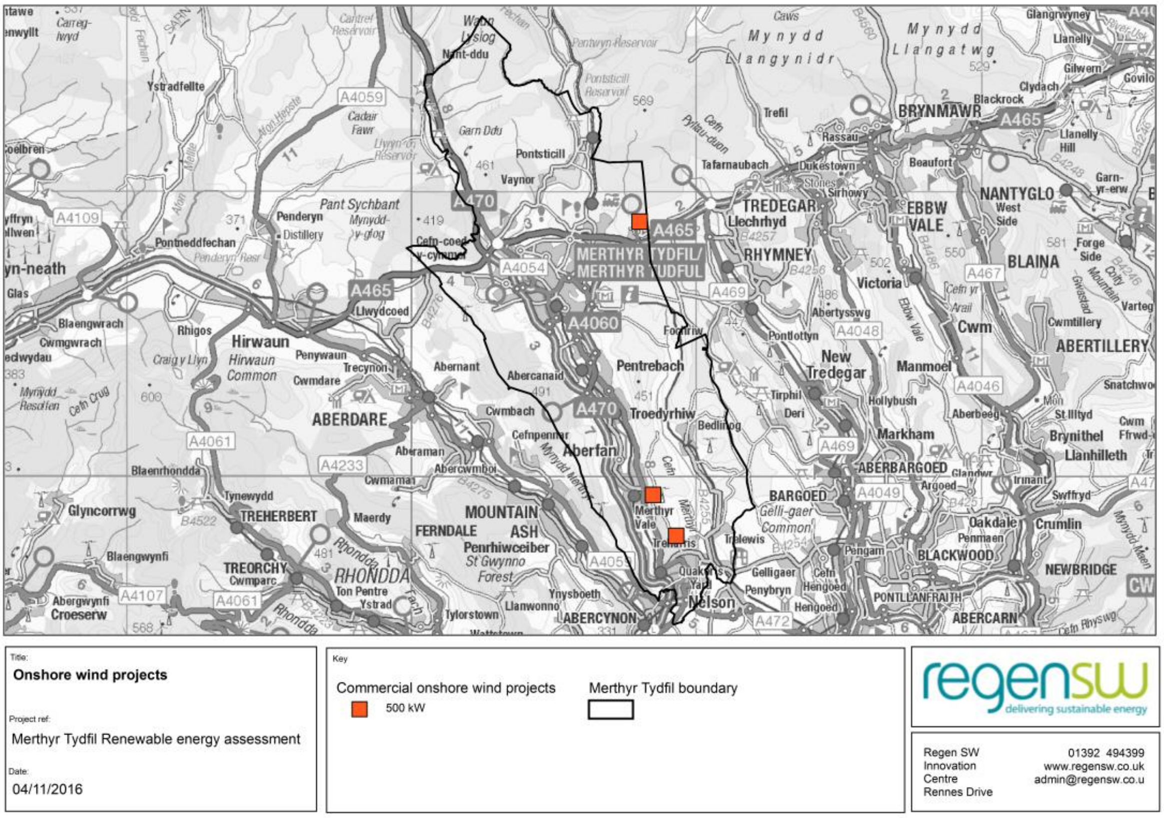

Figure 11: Installed commercial onshore wind projects across Merthyr Tydfil

4.8 Solar PV

4.8.1 Domestic solar PV

Domestic solar PV has seen steady growth across Wales since 2011. Domestic installations for solar PV make up the majority of renewable energy projects in Merthyr Tydfil accounting for 91 per cent of all operational renewable energy projects in the authority, and 16 per cent of total capacity. The average installation size is just over 3kW. Around 2 per cent of homes have installed PV to date.

Table 9: Details on existing domestic solar PV projects

Number of projects	Installed capacity	Generation	Ownership
	Electricity (MWe)	MWh	Domestic
597	1.83	2,034	597

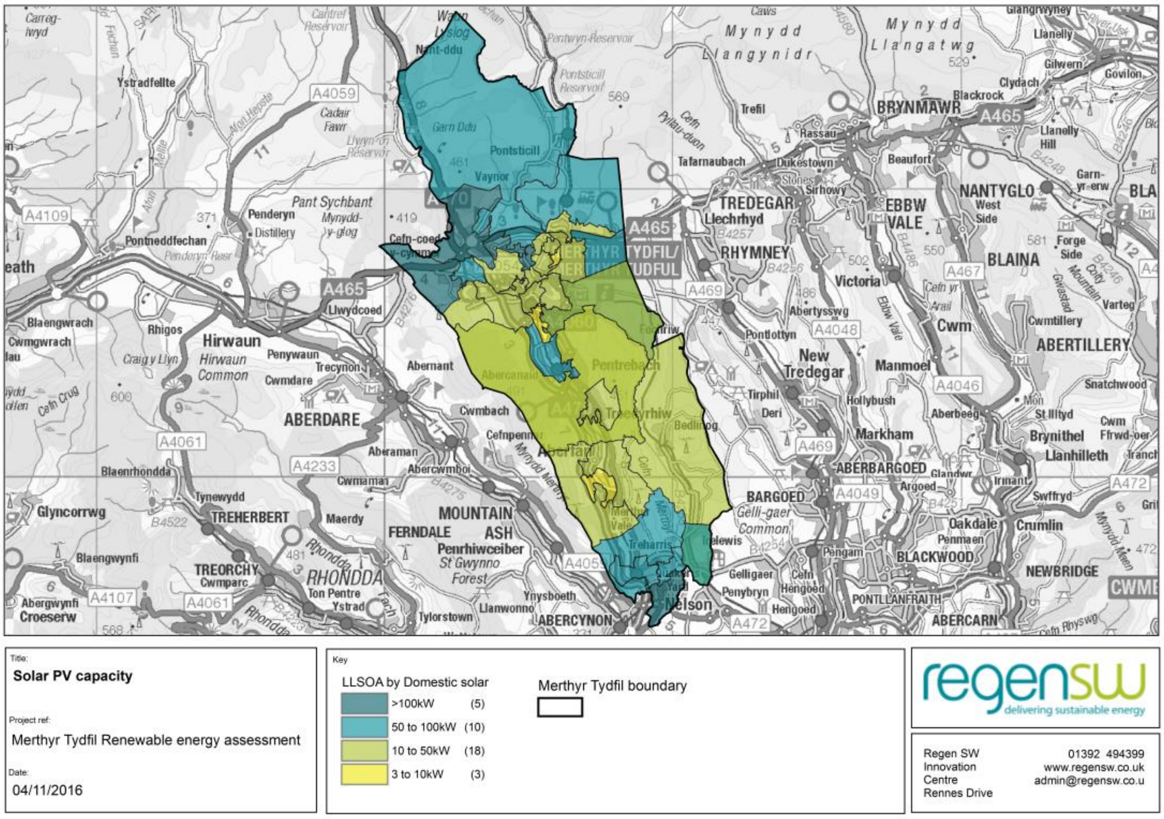

Figure 12: Installed domestic solar PV capacity across Merthyr Tydfil

4.8.2 Commercial solar PV

Currently there are no large-scale ground-mounted solar PV projects in the authority. A 5 MW site at Cwm Bargoed[16] has been granted planning permission (P/15/0169) and is currently under construction. The largest operational community installation is a 73kW project commissioned in 2013.

Table 10: Details on existing commercial solar PV projects

Number of projects	Installed capacity	Generation	Ownership		
	Electricity (MWe)	MWh	Commercial and Industrial	Community	Public sector
17	0.54	595	14	1	2

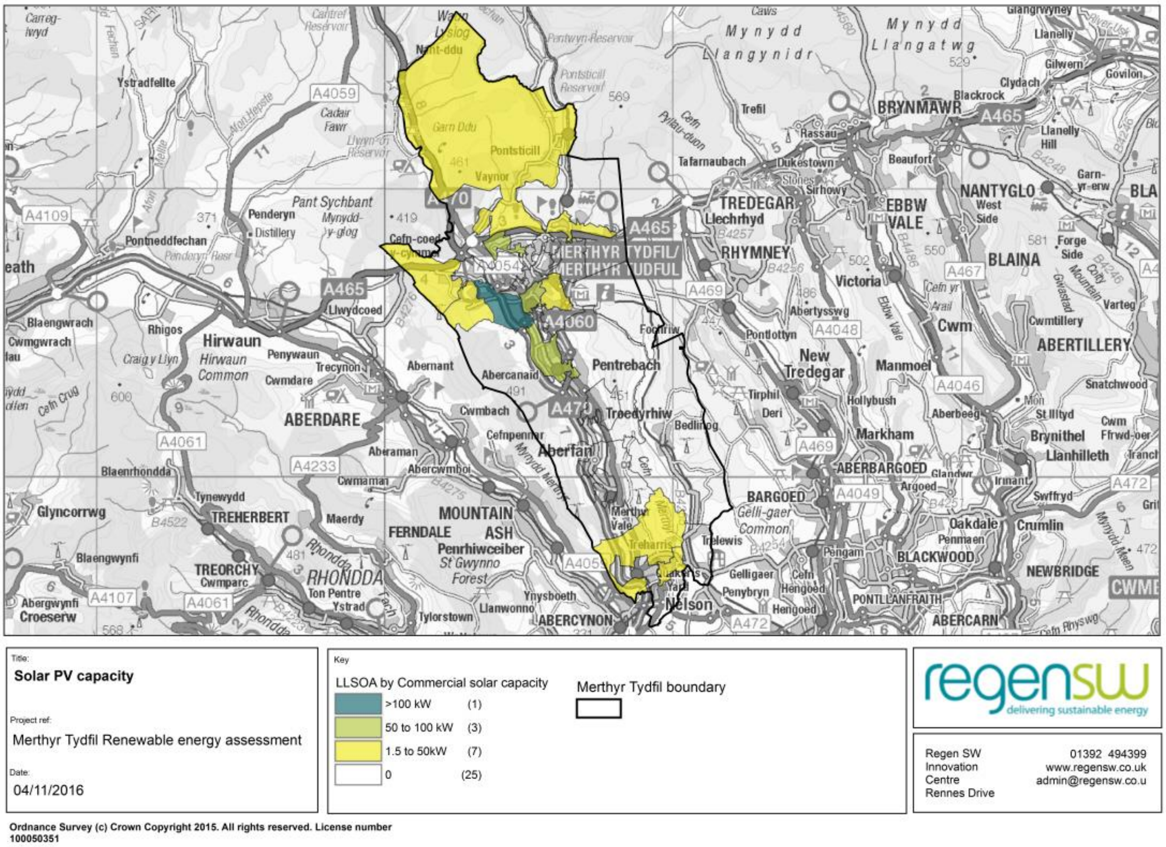

Figure 13: Installed commercial and community owned solar PV capacity across Merthyr Tydfil

[16] Cwm Bargoed solar site is now operational (commissioned March 2017), at the time of compiling operational project data this site was under construction and therefore not included in solar capacity totals.

4.9 Solar thermal

Solar thermal for domestic use has grown at a low rate, with the first project in Merthyr Tydfil installed in 2010. The technology has never reached particularly high deployment levels, especially in Wales and future installation rates are expected to decline, as costs of PV continue to fall and provide a more attractive investment opportunity.

Table 11: Details on existing solar thermal projects

Number of projects	Installed capacity	Generation	Ownership	
	Electricity (MWth)	MWh	Commercial	Domestic
16	0.032	20	1	15

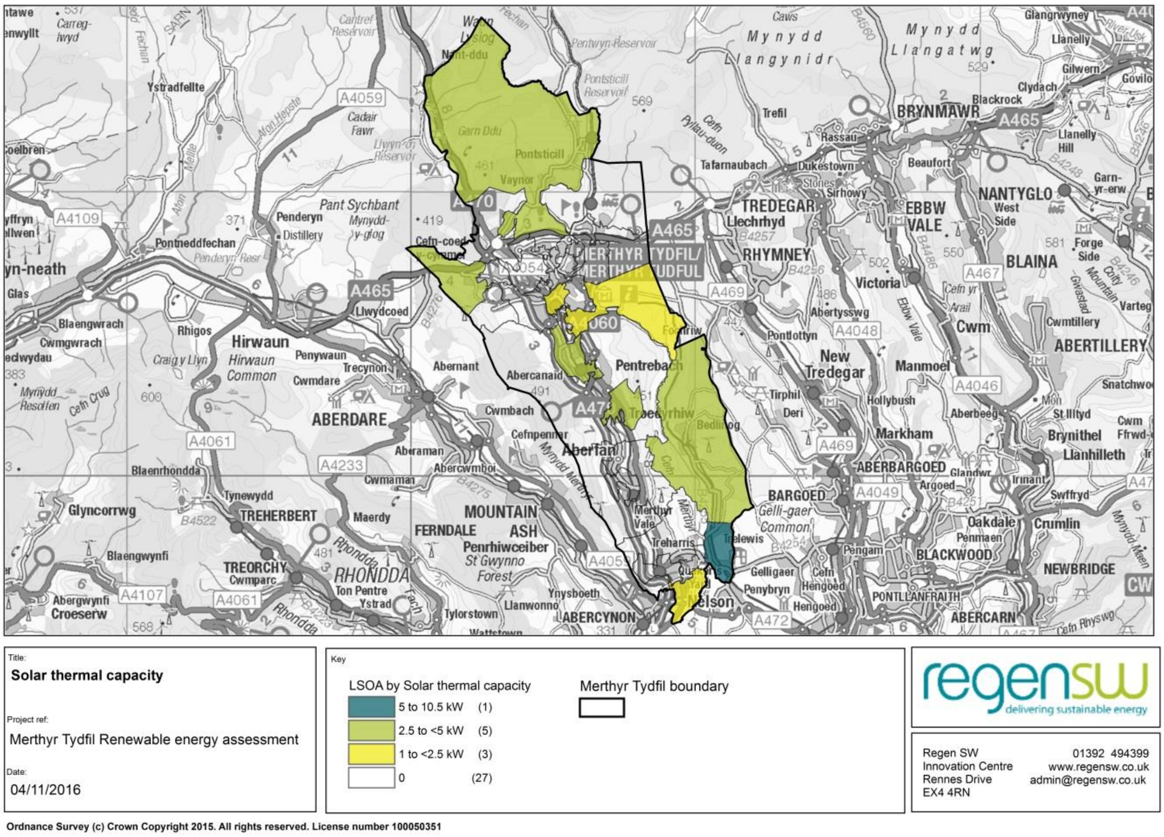

Figure 14: Installed solar thermal capacity across Merthyr Tydfil

5. E1 Task 3: Wind energy resource assessment

5.1 Method

A desk based resource assessment for medium and large-scale wind turbines was undertaken for this study using MapInfo GIS software. The resource assessment was carried out for two different scales of wind turbine: 2 MW turbines and 500kW turbines. 2 MW turbines are large scale turbines and 500kW turbines are considered medium scale. Hub height varies depending on the model of turbine, however, average heights might be:

- 80 to 100m for 2 MW turbines
- 45 to 60m for 500 kW turbines

To find any areas of unconstrained land with potential to develop wind turbines, we applied the assumptions from the national resource assessment methodology commissioned by the Department for Energy and Climate Change in 2010. We followed this methodology for the assessment of large scale potential, with some additional considerations taken into account relating to features of the Merthyr Tydfil area. The assumptions were then adjusted appropriately for the medium scale assessments.

5.2 Assumptions

A number of assumptions were made for the two scales of turbines, which are primarily based on the SQWenergy methodology, and are similar to the AECOM Practice Guidance toolkit[17]. The assumptions are set out below.

2 MW scale resource assessment:

Table 12: Assumptions for 2 MW wind resource assessment

Assumption	Explanation
An exclusion area was applied to the following key features: • **Roads (Motorway, Primary, A & B): 150m = turbine topple height + 10 %** • **Railway: 150m = turbine topple height + 10 %** • **Rivers: 50m**	For roads and railway: safeguarding against the unlikely event of a turbine falling over For rivers: avoiding blades extending over the waterway
The following types of historic area were removed:	Protecting the historic environment in line with national policy

[17] http://gov.wales/topics/planning/policy/guidanceandleaflets/toolkit-for-planners/?lang=en

• **Ancient scheduled monuments with 200m buffer** • **Historic Parks and Gardens**	
Areas with the following environmental designations were excluded: • **Special Protection Areas** • **Special Areas of Conservation** • **National Nature Reserves** • **Local Nature Reserves** • **Sites of Special Scientific Interest** • **Ramsar sites** • **RSPB Reserves**	Protecting the natural environment
Areas with landscape designations were excluded: • **National Parks** • **Areas of Outstanding Natural Beauty**	Protecting designated landscapes
Wind speed below 6.2 m/s at 80m excluded	Minimum wind speed considered necessary for turbines to be economically viable
600m dwelling noise mitigation buffer	600m is an estimated distance to protect homes from noise from wind turbines. Specific sites could be closer than 600m to housing if the site conditions allow it – e.g. there are hills between the turbines and the homes. Additional analysis was carried out to remove miscellaneous buildings such as barns from the buffering and to add any houses that were missed using satellite mapping.
Unavailable areas removed	With local knowledge aided by Merthyr Tydfil County Borough Council, areas where wind turbine development is not possible were removed, such as those where housing development is planned.
Unfeasible areas removed	Small areas of land that are, for example, inaccessible or on steep slopes were removed from the unconstrained area at the end of the process.
Miscellaneous sites	The Ffos-y-Fran site has the potential for wind turbine development especially as it is located near the Goat Mill Road potential development areas,

	which offers opportunity for a private wire agreement to meet new demand. However, as the Ffos-y-Fran Restoration Strategy (2024) and Aftercare (+5yrs) is not deemed to be completed until 2029. Furthermore, the technical ability of the restored landform (which is intended for grazing, and would not be compacted) to be stable enough to take the pressures of rotating turbine bases and their associated infrastructure would need to be assessed, along with the increased ground compaction affecting agreed and planned water runoff rates from the area.
Installed capacity per km² - Benchmark figure 10 MW per km²	The Practice Guidance toolkit states based on the use of 2 MW turbines, it is possible to fit 5 turbines into 1km². This equates to an installed capacity of 10 MW per km², based on relatively widely spaced turbines.

Whereas for the solar resource assessment a 2 km buffer to the electricity grid was presumed (see section 5), this was not applied for the wind assessment as wind projects are more financially viable and tend to be able to afford a lengthier connection distance to the grid.

500 kW scale wind resource assessment:

For the 500kW scale resource assessment, the 2MW resource constraints were applied as above with the adjusted constraints shown in Table 13: Assumptions for 500kW wind resource assessment.

Table 13: Assumptions for 500kW wind resource assessment

Assumption	Explanation
Wind speed below 6.2 m/s at 45m excluded	500kW turbine hub heights vary greatly, so this was considered an appropriate assumption on the basis that wind speeds below 6 m/s would not be economically viable.
450m dwelling noise mitigation buffer	400m was considered to be appropriate noise mitigation buffering for this scale of wind turbine.
Unfeasible areas removed	In addition, areas that were more than 2km from a 33kV or higher power line were removed, as the cost of connection to the grid at a greater distance than this becomes unviable at this scale of turbine.

100m road and railway buffer	Given 500kW hub heights vary greatly, approximate turbine topple height plus 10 per cent. Adjusted from 150m for 2 MW+ turbines.
Installed capacity per km² – one to two turbines per area identified	It is unrealistic on a large scale to have a wind farm of 500kW turbines; higher capacity turbines are more likely to be used. 500 kW turbines are more appropriate for small sites with one or possibly two turbines. Therefore, the larger resource areas suitable for 2 MW turbines have been removed. However, in reality a range of turbine sizes are likely across the whole resource.

5.3 Cumulative impact, landscape consideration and grid constraints

Cumulative and landscape impact can only truly be assessed on a site by site basis and both are key factors in the assessment of a planning application. Cumulative and landscape impact are not usually considered in a resource assessment; however, they are important considerations for the deployment of wind turbines in any area and will be considered in the Sustainability Appraisal of the Local Development Plan (LDP). Likewise, grid constraints can have a significant impact on the deliverability of wind projects, with high connection costs or the need for reinforcements rendering some projects unviable. We have considered cumulative impact and grid constraints with regard to policy formulation later in this study.

5.4 Limitations of this method

The method employed in this resource assessment is not a site finding method. Instead, it is about trying to estimate the potential for wind turbines across the Merthyr Tydfil area. In order to estimate the potential, locations were identified that might be suitable for turbines using coarse criteria applied uniformly across the area. There is no guarantee that more detailed site searches will bring forward sites in these locations. Sites might also exist outside of these areas, as specific site conditions may allow for constraints to be relaxed. For example, 2 MW turbines could be located closer than 600m to homes if topography means that noise will not be an issue at that distance.

The results can however be used to understand the potential for the deployment of wind turbines in Merthyr Tydfil and to draw from this an understanding of the contribution that onshore wind can make to renewable energy generation in Merthyr Tydfil. The results have been used to inform a reasonable maximum potential – there is no implication that the total number of turbines will be developed in the area. The number of turbines that come forward will be determined by wind developers, landowners and communities proposing projects.

5.5 Results

Table 14 shows the results of the resource assessment for 2 MW turbines. The total area is a combination of all potential sites, with a cumulative installed capacity. Also set out, is the number of turbines that this installed capacity relates to. The 2 MW assessment assumes all the turbines in those areas would be 2 MW scale turbines, however a mixture of scales could be deployed.

Table 14: Results of 2MW wind resource assessment

Size of turbine	Total unconstrained area with landscape consideration	Installed capacity per km²	Installed capacity for unconstrained area with landscape consideration	Number of turbines (5, 2MW turbines in 1km²)
	km²	MW/ km²	MW	
2 MW	4.3	10.0	43	21

The table below outlines how many additional small individual areas of land there are which could be suitable for a 500kW turbine. It is assumed that between one and three 500kW turbines could be sited in each area.

Table 15: Results of additional 500kW wind resource assessment

Size of turbine	Number of additional areas of land	Number of turbines in each area	Installed capacity
			MW
500 kW	7	1-3	6

5.6 Energy and carbon saving results for wind assessment

Table 16 sets out the energy that each scale of turbine could generate if the maximum number of turbines were deployed, with the resulting carbon savings estimated and the equivalent number of households' electricity use that could be generated. The 500kW resource is for additional areas not suitable for larger turbines so can be added to the 2 MW resource.

Table 16: Annual energy generation and carbon savings potential from potential wind resource

Size of turbine	Maximum potential installed capacity	Annual energy generation	Annual CO_2 saving	Number of households' electricity use
	MW	MWh	tonnes	homes
2+ MW	43	101,635	41,873	30,249
500 kW	6	14,191	5,847	4,223

Assumptions		
Capacity factor	27	per cent
Total consumption emission factor for electricity (kg CO_2 /kWh)[18]	0.412	kg
Merthyr Tydfil average annual household electricity demand (BEIS 2015)	3,360	kWh

[18] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016

5.7 Areas identified with greatest potential to accommodate large scale wind

Nine locations were identified as having potential to accommodate 2+ MW turbines, plus an additional seven areas with potential for 500kW turbines. These areas are mapped in Figure 16 to Figure 24 below. The electricity grid is also shown, as whilst proximity to the network is not a constraint applied in this resource assessment, it is an important factor to consider in siting projects. The areas identified are those that are left once all the constraints listed in Table 12 have been applied.

These areas are not definitive: due to the relatively high-level nature of a resource assessment, some sites with potential may come forward outside of the areas and wind development in the areas themselves will depend on wind developers, landowners or communities identifying potential projects following more detailed site-specific analysis.

The features of the nine large scale locations are set out below in green. These locations have been mapped on a GIS layer for the Council, allowing for review of the resource assessment in the future as constraints change.

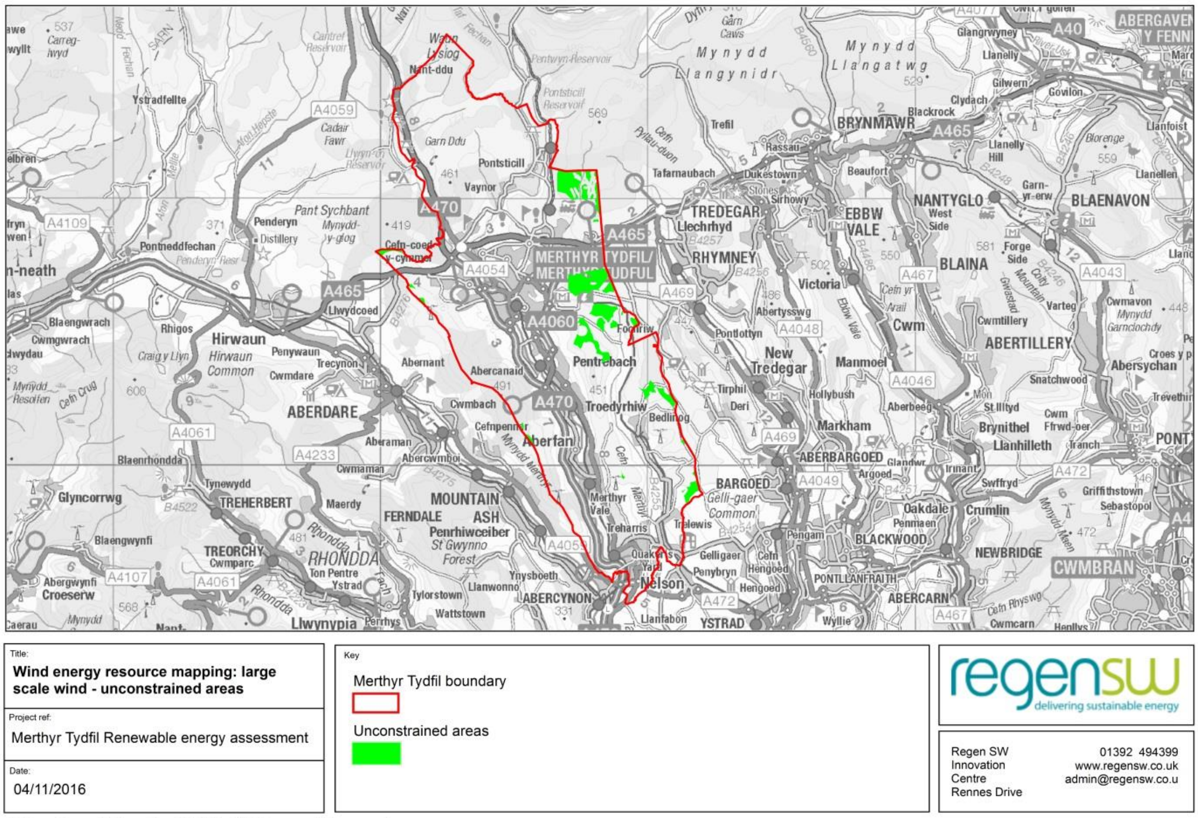

Figure 15: Areas identified with greatest potential to accommodate large scale wind turbines

Each area identified in the resource assessment is set out in more detail below with comments from our site analysis for each site area.

5.7.1 Area 1 – Merthyr Road and A465

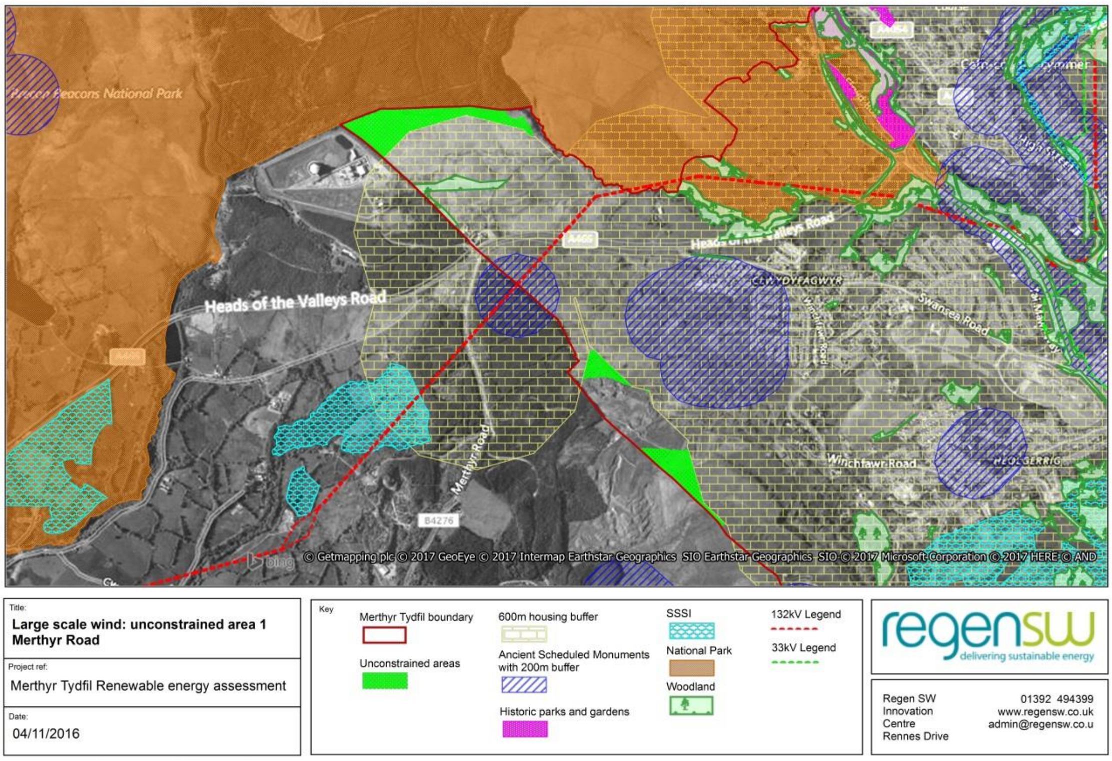

Figure 16: Area 1 – Merthyr Road and A465

Factors to consider:

- Access to site during construction
- Location is surrounded by several environmentally protected areas:
  - National Park
  - SSSI
- The visual impact could be significant from dwellings in Pant, as the resource is located near to the top of the slope
- The historic tip nearby, which is a protected area
- Scheduled Ancient Monuments nearby
- 132kV line runs approximately 0.5km from site areas, a consideration regarding connection costs

5.7.2 Area 2 – North of Pant

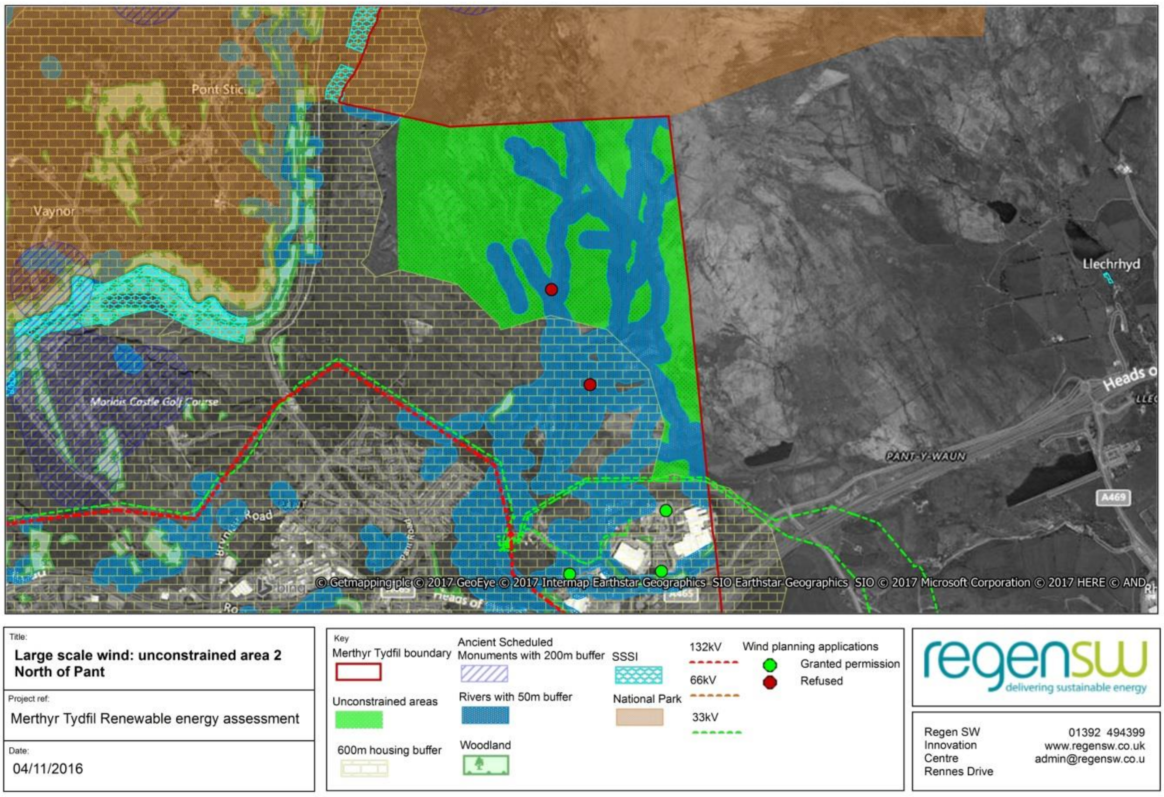

Figure 17: Area 2 – North of Pant

Factors to consider:

- Potentially difficult access for large turbines during construction
- Close to National Park boundary
- Close to several environmentally protected areas
  - Scheduled monuments
  - SSSI
- Significant visual impacts may arise as site area is located on slope/top of hill
- Golf course and Brecon Mountain railway nearby
- Planning applications (P/06/0573, P/04/0361 and P/13/0383) for 10 turbines, 5 turbines and 1 turbine sites, all refused due to the unacceptable adverse impact of the development on the quality and character of the landscape, the setting of the Brecon Beacons National Park and the ecology of the area, particularly the water environment
- There is one operational 500kW turbine on the industrial site, commissioned in 2013; this area could quickly reach its capacity due to cumulative impact.

5.7.3 Area 3 – Ffos-y-fran

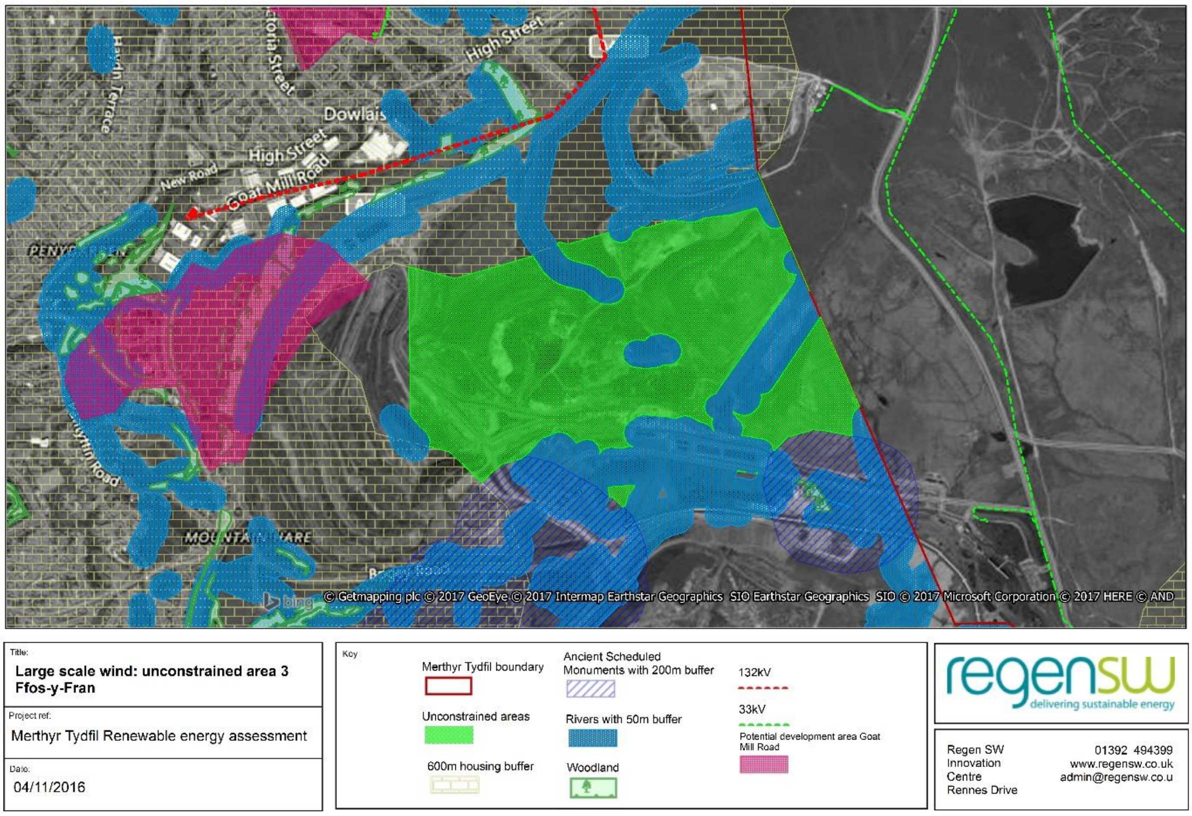

Figure 18: Area 3 – Ffos-y-fran

Factors to consider:

- Part of this area is within the Ffos-y-Fran Restoration Strategy (2024) and Aftercare (+5yrs), which is not deemed to be completed until 2029
- The technical ability of the restored landform (which is intended for grazing, and would not be compacted) to be stable enough to take the pressures of bases for rotating turbine and their associated infrastructure, would need to be assessed, along with the increased ground compaction affecting agreed and planned water runoff rates from the area.
- Potentially significant visual impacts given the proximity to housing
- Close to Goat Mill Road development area which will have commercial employment land and therefore a potential opportunity for private wire agreement.

5.7.4 Area 4 – Cwm Bargoed

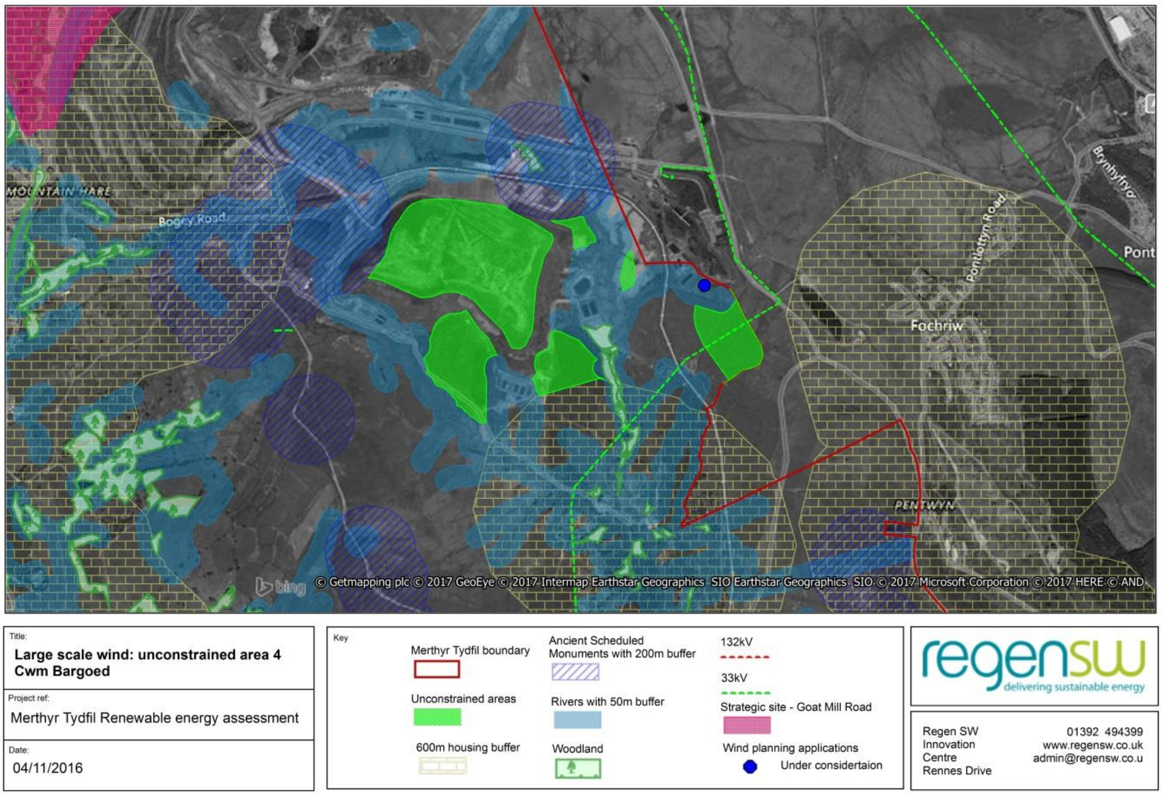

Figure 19: Area 4 – Cwm Bargoed

Factors to consider:

- Visual impacts potentially significant with housing nearby
- Near scheduled monuments
- A solar farm already granted planning permission (P/15/0169)
- A single wind turbine application refused (P/17/0004).

5.7.5 Area 5 – East of Pentrebach

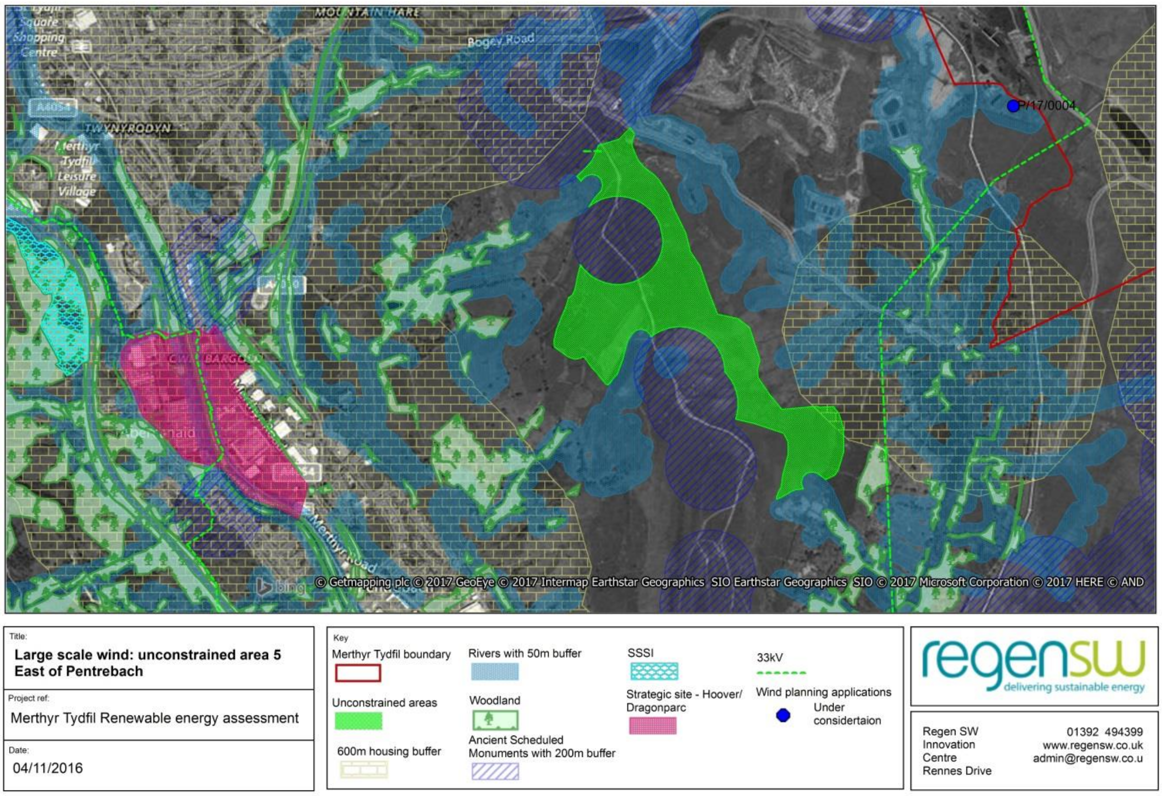

Figure 20: Area 5 – East of Pentrebach

Factors to consider:

- Large area but with several possible major constraints
- Visual impact significant as area near the top of a slope
- Scheduled monuments 200m from area
- Hoover/Dragonparc potential development areas 1.5km from resource area, offering potential private wire agreements on employment land

5.7.6 Area 6 – North of Bedlinog

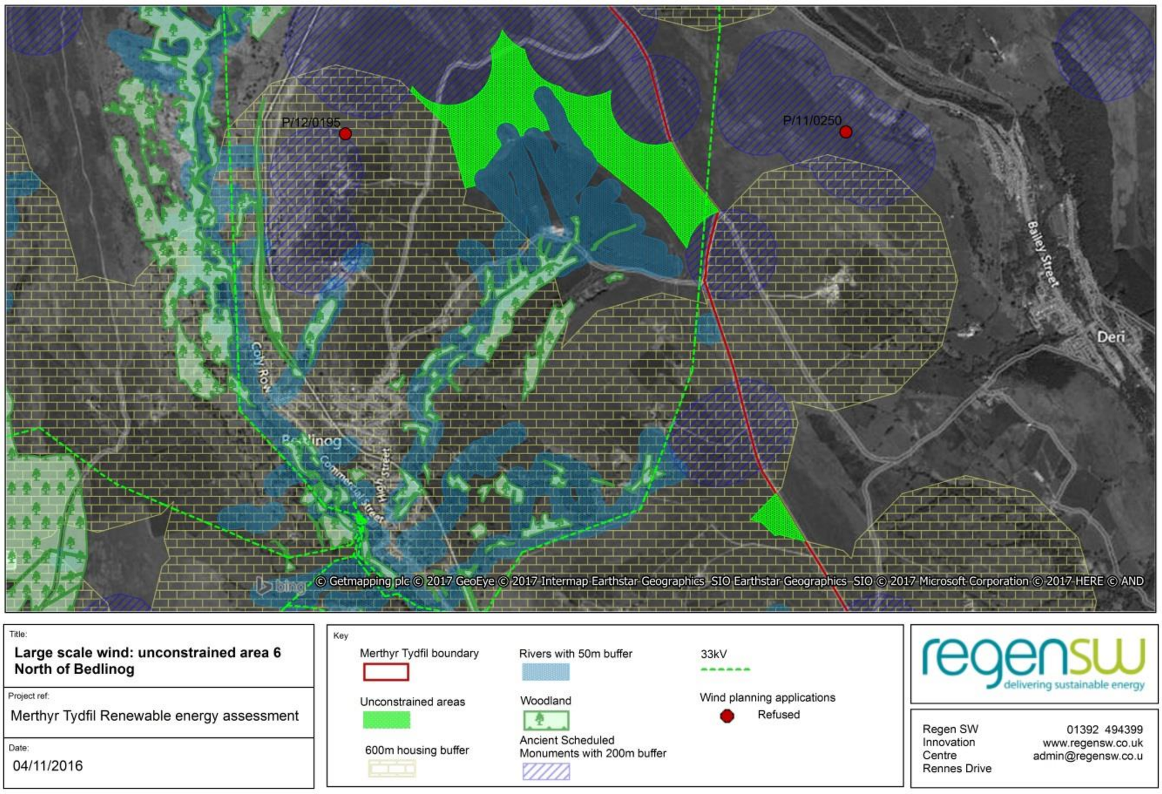

Figure 21: Area 6 – North of Bedlinog

Factors to consider:

- Two previous wind applications refused planning P/12/0195 and P/11/0250 (Bedlinog community wind project) due to significant adverse effect on the landscape, adjacent ridge landscapes and the setting and special qualities of the Gelligaer Common
- One solar application also refused planning (P/15/0254) due to the development's size and siting which would result in an inappropriate development in a sensitive rural setting

5.7.7 Area 7 – North East of Trelewis

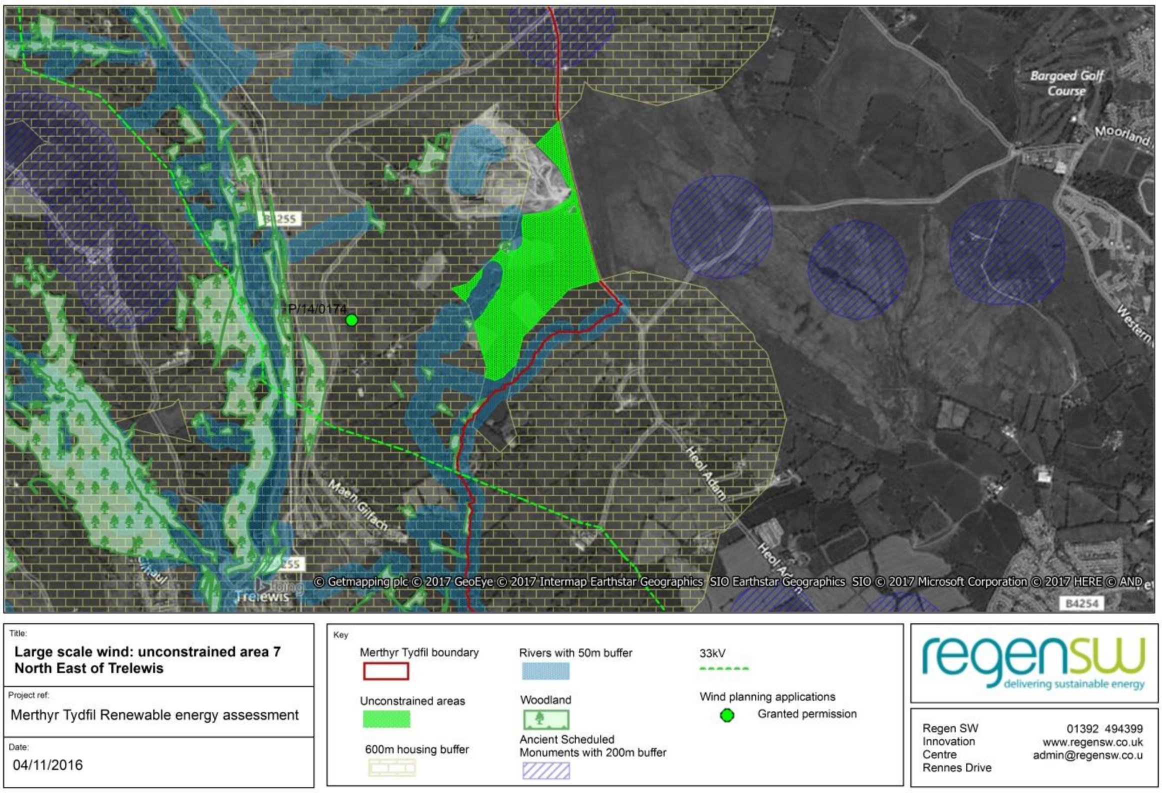

Figure 22: Area 7 – North East of Trelewis

Factors to consider:

- One 5kW wind application nearby granted planning permission (P/14/0174)
- Area near the top of the slope, potentially having visual implications for nearby housing.

5.7.8 Area 8 – Nant-Y-Fedw Farm

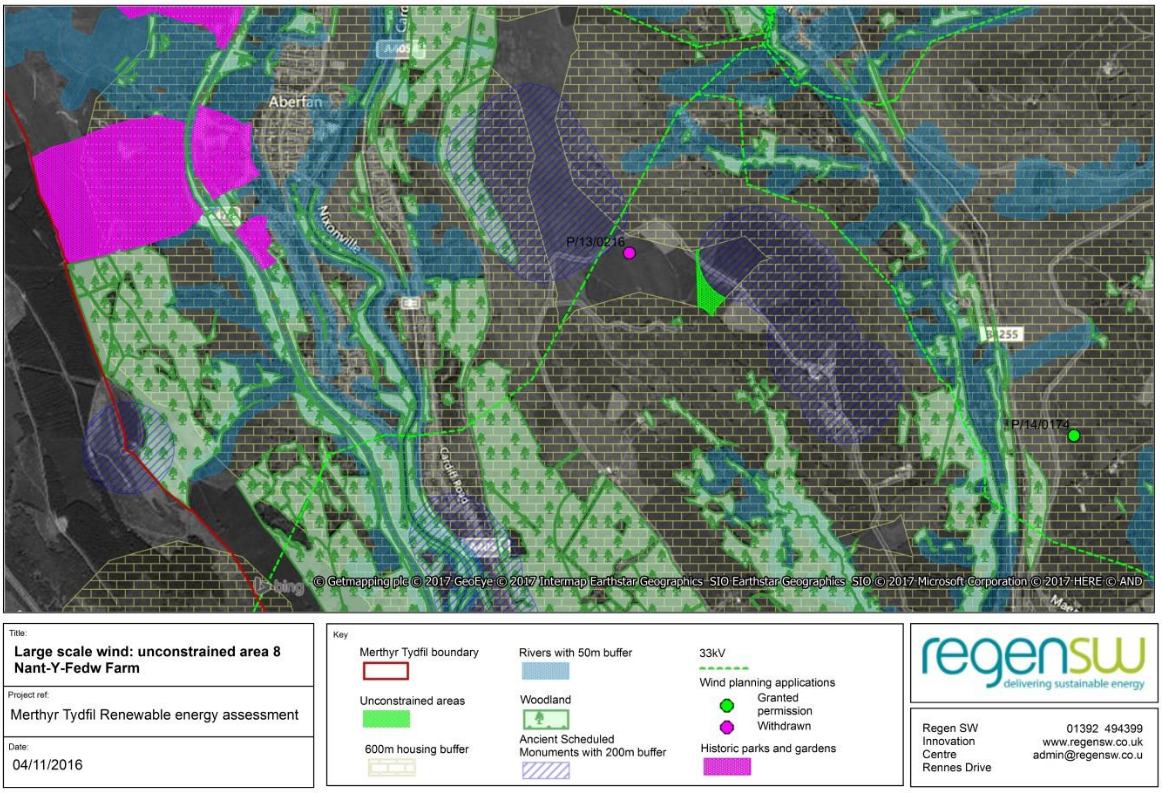

Figure 23: Area 8 – Nant-Y-Fedw Farm

Factors to consider:

- Nearby application for a single 500kW wind turbine has been withdrawn (P/13/0216)
- Potential visual impact on historic park and garden Aberfan Cemetery
- Scheduled monuments 200m away
- Visual impacts for nearby housing would need to be considered as the resource area is near the top of a slope
- Two operational 500kW sites nearby (Figure 11).

5.7.9 Area 9 – West of Aberfan

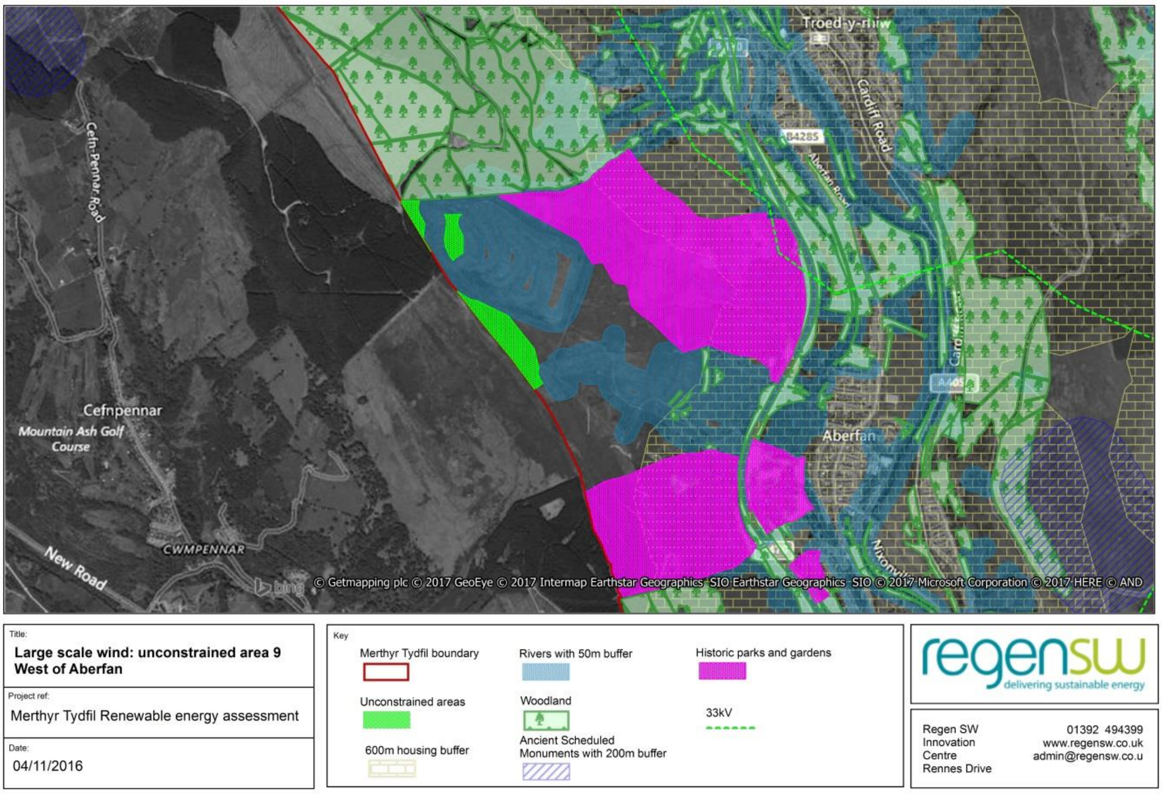

Figure 24: Area 9 – West of Aberfan

Factors to consider:

- Proximity to the Aberfan Cemetery makes development unlikely here
- Visual impact for nearby housing would need to be considered as the resource area near the top of a slope.

5.8 Medium-scale wind 500kW

The map below shows the seven additional areas that have been identified with the greatest potential for medium scale (500kW) wind turbine developments, offering the potential for a further 6 MW of capacity. This approach highlights how smaller parcels of land can appear when assessing the potential for smaller turbines, largely due to the lesser noise constraint distance associated with smaller turbines.

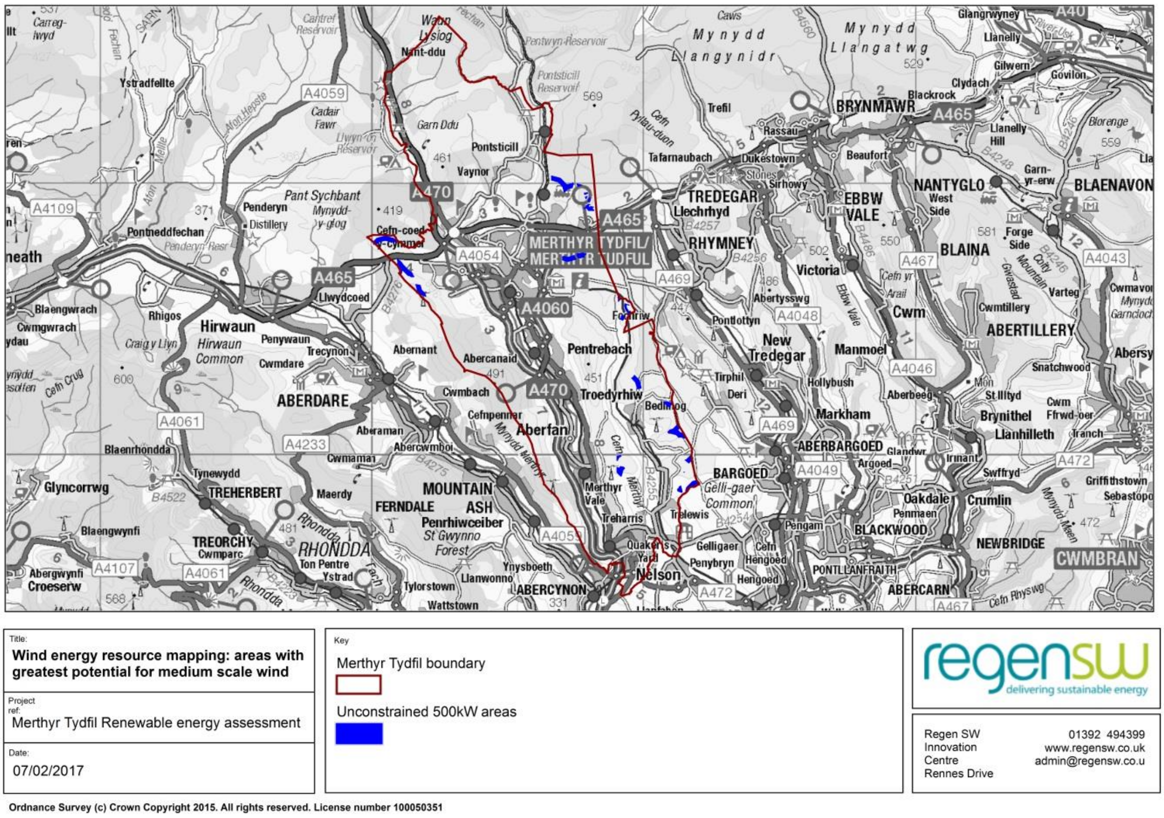

Figure 25: Areas identified with greatest potential to accommodate medium scale wind turbines

5.9 Next steps

This resource assessment is useful to inform debate on the potential for wind energy in Merthyr Tydfil. It demonstrates that locations with potential for medium or large-scale wind are relatively limited and applications that are submitted should be viewed in this context. Planning officers working on policy, or assessing wind applications, should have access to the maps to inform their thinking, although planning applications will not necessarily be located within the areas identified.

The maximum resource potential is used in the analysis of P2, P3 and P4 to further inform site allocations and in understanding the potential for a renewable energy target for the area in P1.

The mapped areas are also useful to prompt landowners and communities to think about whether there are opportunities for wind on their land or in their area. Community-led wind projects have been developed across the UK and the information in these maps could inspire local communities to look in more detail for opportunities in their area. The Council could actively make the results available to landowners and communities for this purpose.

The results of this assessment could also be refined through consultation with wind developers who would swiftly be able to evaluate the potential for sites at these locations, by applying their own site finding processes.

6. E1 Task 4: Biomass Energy Resource

This section assesses the potential resource available in Merthyr Tydfil for harvesting wood fuel and energy crops. It is important to emphasise that biomass is a commodity that can be transported, for example most of the UK's wood pellet is currently produced in the north of England. Although the resource in Merthyr Tydfil is quite limited, in reality if the biomass market does develop in the UK, we would anticipate biomass fuel would be bought in from elsewhere. However, to maximise carbon savings, resource should be sourced as locally as possible, rather than importing fuel from further afield.

6.1 Wood fuel: Method

The method used to establish the amount of available wood fuel resource follows Worksheet C of the AECOM toolkit.

Firstly, the location and extent of forestry and woodland resource available in Merthyr Tydfil was established. Using the National Forest Inventory (NFI) and Natural Resource Wales (NRW) legal boundaries, the resource area was mapped in GIS. The output of this can be seen in Figure 26. The GIS layers used to calculate yield have been provided to the Council. The NFI layer confirms the geographic extent of all woodland in Wales and is owned and maintained by NRW. The second dataset shows the extent of NRW owned and managed land.

Once the total available resource had been identified, the potential sustainable wood fuel yield from this area was calculated. Figures are shown in Table 17.

To calculate how much wood fuel could be usefully and sustainably extracted on an average annual basis, we used the toolkit recommendation and assumed a figure of 0.6 oven dry tonnes of available wood fuel per ha of woodland, per year. An oven dry tonne is a theoretical figure, often used in this type of resource assessment, and represents the weight of crop if it had 0 per cent moisture content.

The toolkit states this figure covers "*a long term, annually averaged sustainable yield, based on wood fuel that can be harvested from the small roundwood stems, tips and branches of felled timber trees and thinnings, as well as poor quality roundwood. This figure takes account of competition from other markets in Wales, such as particle board manufacturing. The figure also takes into account technical and environmental constraints*".

The amount of energy output is dependent on the type of facility that the fuel is used in, as efficiency of the plant and the number of operational hours will vary. For the worked example shown in Table 17, capacity is calculated for a heat only facility using the assumption that 660 oven dry tonnes of wood fuel equates to 1 MWe of installed capacity[19].

[19] http://gov.wales/topics/planning/policy/guidanceandleaflets/toolkit-for-planners/?lang=en

6.2 Wood fuel: Results

The results show a very limited resource within the Merthyr Tydfil boundary, with a potential annual yield capable of supplying around 1.8 MW of heat capacity. However, if biomass installations did take off, wood fuel could be bought in from elsewhere, ideally using local markets, or vice versa wood fuel resource in Merthyr Tydfil could be exported to local demand.

Table 17: Potential wood fuel yield and subsequent energy output

Total available biomass resource (ha)	Forested areas owned and managed by NRW (ha)	Forested areas not owned and managed by NRW (ha)	Average sustainable yield (oven dry tonnes/annum)	Potential capacity (MWth)	Potential annual energy output (MWh)
1,952	1,037	915	1,171	1.77	5,441

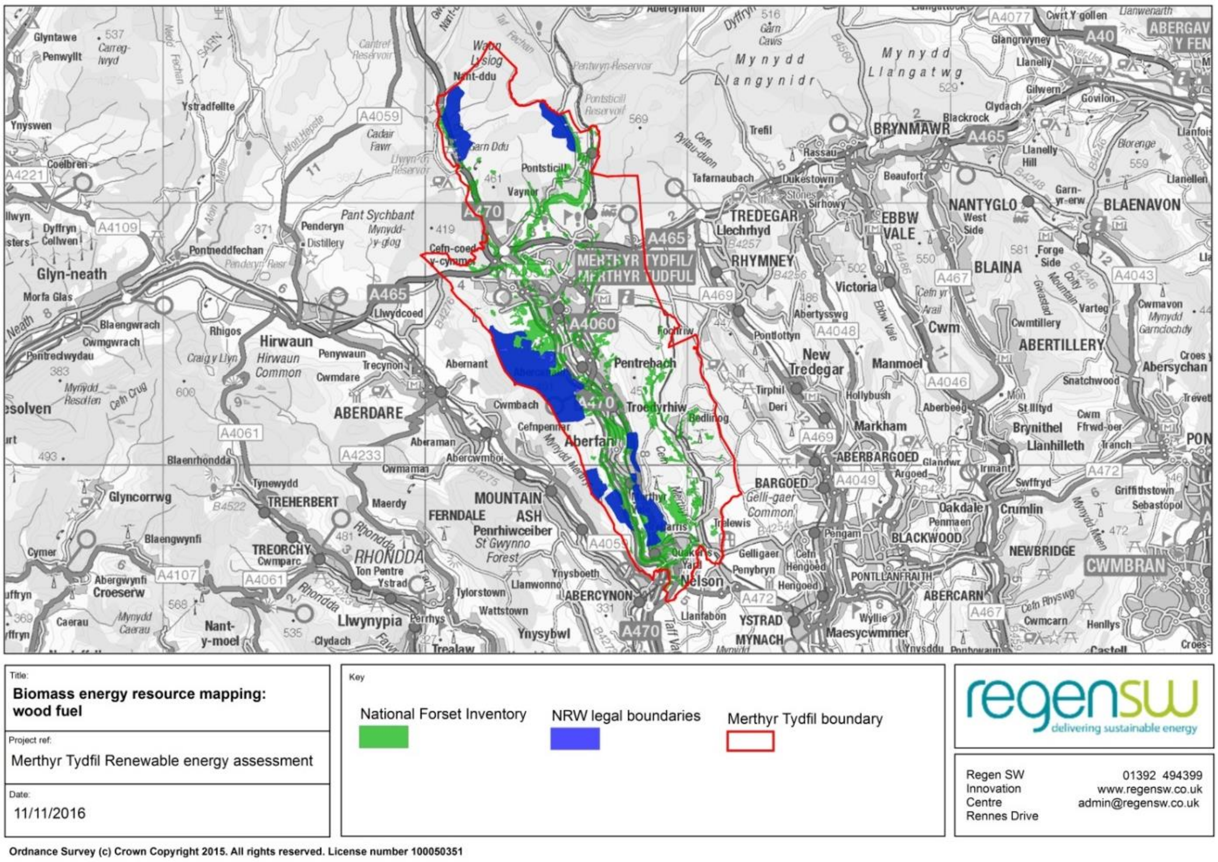

Figure 26: Extent of forestry and woodland resource available in Merthyr Tydfil

A key concern with current large-scale biomass market is the high amount of cheaper wood chip which is imported from North America. If NRW are able to utilise their available resource across Wales, this could provide a sustainable local fuel supply.

6.3 Energy crops: Method

To establish the available resource in hectares of existing agricultural land, we used an Agricultural Land Classification (ALC) map provided by the Council. This was completed through a desk based assessment following the 1988 revised guidelines. This assessment confirms the area has low quality agricultural land with no ALC higher than grade 4.

Only land at grade 4 or above is used to calculate available resource. NFI woodland areas, and sites designated for conservation purposes (Sites of Special Scientific Interest and Scheduled Ancient Monuments) were removed from the suitable grade 4 land. This then enables us to establish the theoretical maximum area that could be planted with energy crops.

From this total, only a proportion of land can be planted with energy crops due to competing demands on this resource. Other crops and livestock are important and established markets, where farmers are able to achieve a far higher return from the land, are likely to take precedence. Nationally, the energy crops market is yet to achieve the levels anticipated in the toolkit, which was originally produced in 2009. There would need to be substantial market drivers in place to convince landowners to plant woody energy crops, as the market is unproven and it takes time for crops to mature. Therefore, to assess current market trends for energy crops in Wales, we spoke to several key industry contacts:

- Farmers Union Wales do not have much involvement with energy crops at present, as the there is no interest from farmers in Wales under current market conditions.
- We also spoke with the Institute of Biological, Environmental and Rural Science (IBERS) at Aberystwyth University. They did highlight that farmers will grow whatever they are confident they have a market for, and whatever will outperform the opportunity costs for alternative land use. Their opinion from talking to key industry stakeholders such as Terravesta, suggests farmers are very open to new crops, but they are wary of the long-term commitment to a perennial crop, particularly if they are waiting three years to start getting a good income.

From this insight, the 10 per cent figure (suggested in the toolkit) for the proportion of available land that could be used to grow energy crops is considered far too high to give a realistic measure of the available resource. This would be dependent on high and guaranteed subsidies. There is some research suggesting certain energy crops, particularly miscanthus can be grown efficiently on different types of marginal land (brownfield sites/land contaminated from mining/floodplains),[20] this could be particularly useful across Wales, as a lot of the land is ALC grade 4 or 5.

We have therefore applied a 5 per cent figure to the calculations in Table 18 as a more approximate amount for the uptake that could be viable. This remains an optimistic estimate given the current low uptake, but has been selected to account for progress we may see in this market up to 2031.

To establish potential annual fuel yield from the total available area, we used the figure recommended in the toolkit; for miscanthus and short rotation coppice about 12 oven dry tonnes should be produced per hectare.

[20] Elaine Jensen from IBERS at Aberystwyth University has been looking into the yield of Miscanthus and other energy crops on different types of marginal land. They have yield prediction models for Miscanthus, SRC and reed canary grass for different land classes.

The energy crops capacity and generation calculations follow a similar structure to the wood fuel assessment. Once again, these figures are dependent on the type of facility the fuel is used in. The calculations below show outputs for both CHP and heat only projects. These figures follow those suggested in the toolkit. For electricity capacity, a biomass facility will require about 6,000 oven dry tonnes of energy crops for each 1 MWe of installed power generation capacity. A CHP facility would also have another 2 MWth capacity in addition to the electricity output. As mentioned above, a heat only facility will require around 660 oven dry tonnes of energy crop for each 1 MWth of installed thermal generation capacity.

The capacity factors for biomass given in the latest regionalised capacity factors from BEIS[21] were then applied to calculate potential generation. For Wales, these figures are currently 70 per cent for biomass electricity and 35 per cent for biomass heat.

6.4 Energy crops: Results

The available resource for energy crops is quite limited in Merthyr Tydfil due to the amount and grade of agricultural land. Similar to the wood fuel assessment, it is much more likely that fuel supply would be bought from elsewhere. This is clearly dependent on demand and the growth of biomass boilers in Merthyr Tydfil. Our assessment of growth in this technology can be reviewed in section 9 E2 Building integrated renewables uptake assessment

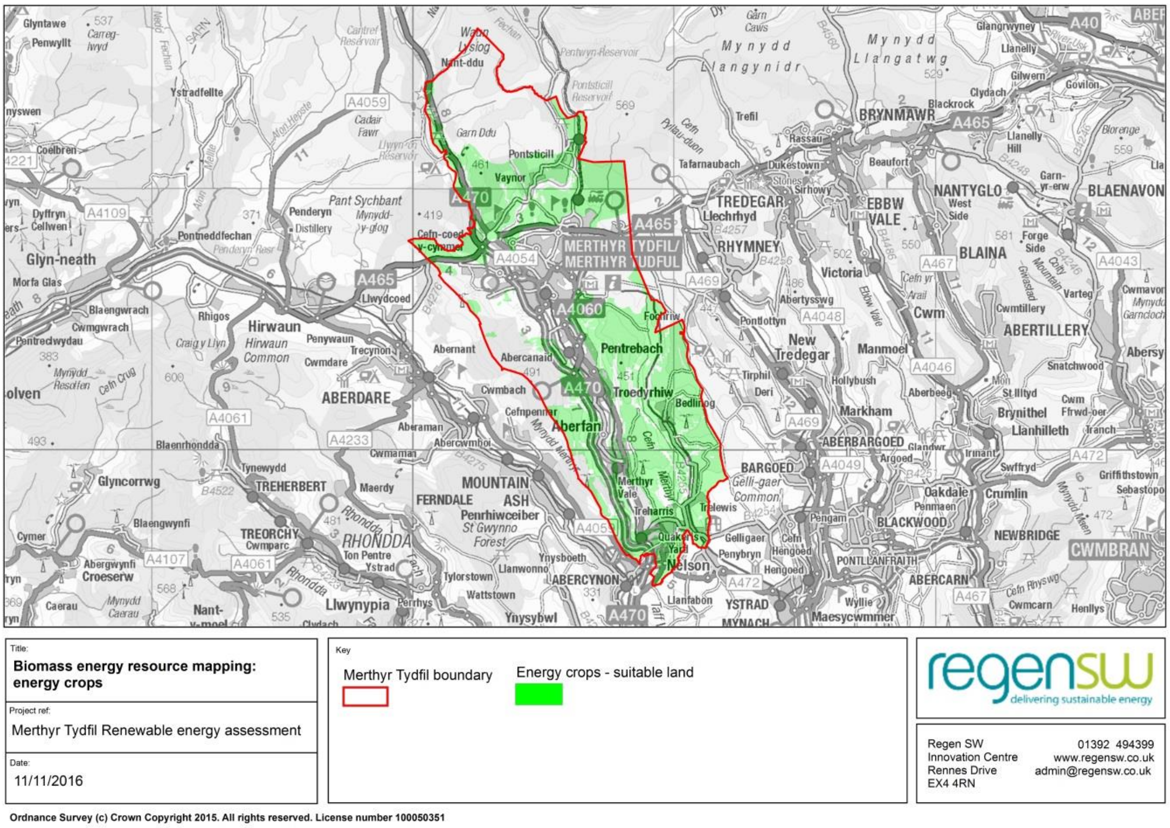

Figure 27: Extent of suitable land in Merthyr Tydfil

21 https://www.gov.uk/government/statistics/regional-renewable-statistics

Table 18: Potential energy crop yield and subsequent energy output

Energy crop potential	
Agricultural land (suitable grade 4 and higher)	6,415
Theoretical suitable area (Woodland and land constraints removed) (ha)	4,906
Suitable land that could be planted (ha)	245.3
Potential annual fuel yield from suitable land (oven dry tonnes/annum)	2,943.6
Potential electricity capacity (CHP electricity) (MWe)	0.49
Potential heat capacity (CHP heat) (MWth)	0.98
Potential heat capacity (heat only) (MWth)	4.46
Annual electricity output (CHP electricity) (MWh)	3,008
Annual heat output (CHP heat) (MWh)	3,008
Annual heat output (heat only) (MWh)	13,674

7. E1 Task 5: Energy from Waste - Municipal Solid Waste (MSW) and Commercial and Industrial (C&I) Waste

7.1 Method

To establish the quantity of residual MSW and C&I waste available, we spoke to the MTCBC waste officer, who provided insight into the waste strategy for Merthyr Tydfil up to 2031.

7.2 Results

In April 2016, MTCBC entered into a 25 year contract to treat residual waste through the energy from waste plant at Trident Park in Cardiff. Therefore, any available MSW resource will be sent to this plant until 2041. This site still has capacity to take more resource if there is growth in MSW over the contract period.

MTCBC's waste officer emphasised the waste management strategy in Merthyr Tydfil is focussed on reduction rather than energy recovery, in line with the waste hierarchy in national policy. MTCBC provided waste projections from their Waste Strategy business case, see Figure 28. This shows how they anticipate the residual waste resource to be relatively constant over the coming years, as waste reduction and recycling campaigns counter any increase from population growth.

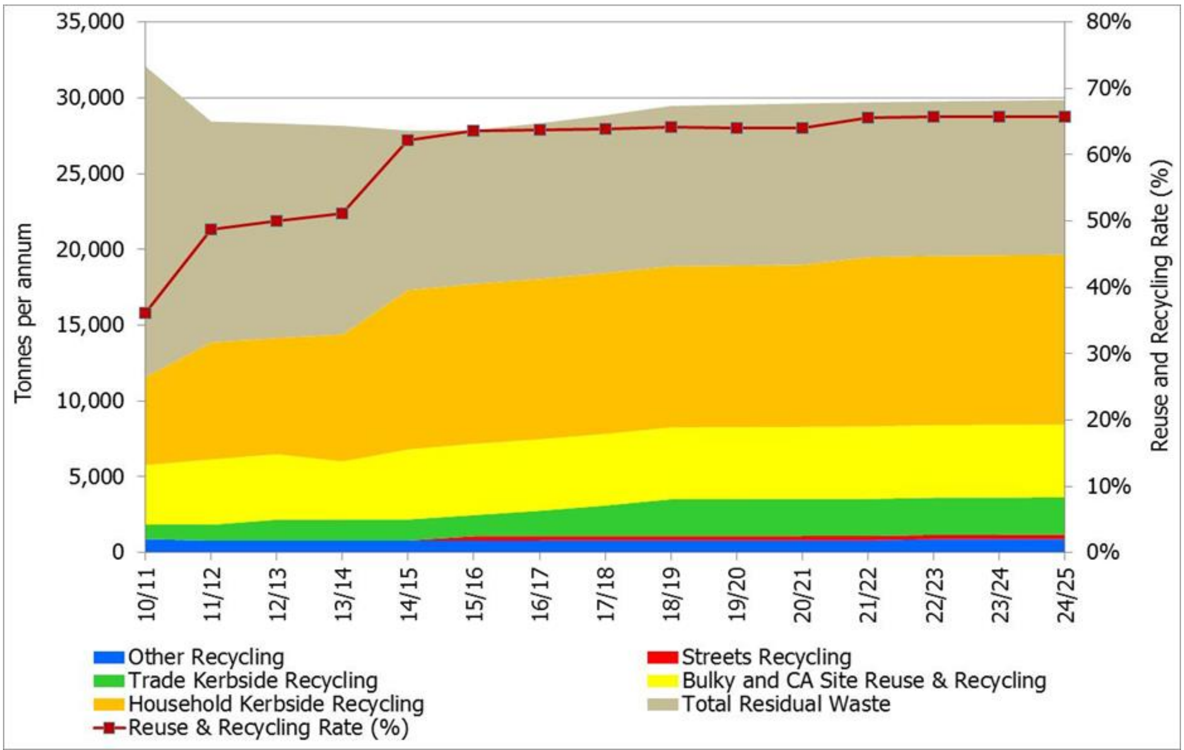

Figure 28: MTCBC Waste projections to 2025

Commercial and industrial waste is not the Council's responsibility. However, the new Enviroparks Hirwaun plant in neighbouring Rhondda Cyon Taf will likely take any surplus commercial and industrial waste from the area. Phase 1 of the project which began construction in March 2015, consists of a materials recycling and fuel preparation facility. Phase 2 will see the development of a gasification plant to produce electricity from the fuels produced on site by Phase 1. Finally, Phase 3 will focus on producing electricity from organic wastes via an advanced anaerobic digestion facility.

Waste projection figures alongside the existing waste contract and surrounding developments show local resource is insufficient to supply a new energy from waste plant in the Merthyr Tydfil area.

8. Waste resource for anaerobic digestion

8.1 Method

Anaerobic digestion resource uses three main fuel sources: farm waste, food waste and sewage sludge. To establish the total available resource for each, the following method was used, again using figures suggested in the toolkit.

8.1.1 Food waste

For food waste, we considered the impact of existing AD plants in the surrounding area which already use much of the food waste resource from Merthyr Tydfil, alongside information provided to us by the MTCBC waste officer. Details are given in the results section below.

8.1.2 Sewage sludge

We contacted Welsh Water's Energy Programme Manager to identify the resource available from sewage for energy recovery in the Merthyr Tydfil area. They also provided market insight and explained their future plans for AD plants across Wales.

8.1.3 Cattle slurry

To calculate the available resource from animal slurry, we used the Welsh Government's Agricultural Land Survey (2015)[22] to establish the number of cattle and pigs in Merthyr Tydfil. From this, we calculated the tonnage of available waste using the following figures:

- Cattle: 1 tonne per month per head
- Pigs: 0.1 tonnes per month per head

As slurry is collected when livestock are kept under cover, we have assumed slurry is available for 6 months of the year; therefore annual slurry quantity equates to:

- Cattle: 1 x 6 = 6 tonnes/head
- Pigs: 0.1 x 6 =0.6 tonnes/head

In reality not all this slurry will be available or practical to collect, because farms either do not use a slurry system or because farms are too small or dispersed for collection to be economically viable. As such, we have assumed 25 per cent of the total theoretical resource will be available for use.

To calculate capacity figures, the following assumptions have been made. For electricity generation 225,000 wet tonnes of slurry will be needed per 1 MWe. AD plants can produce waste heat that can be used; typically a 1 MWe engine would also produce 1.5 MWth of thermal capacity. For heat generation only sites, 47,000 wet tonnes of slurry will be needed per 1 MWth[23]. The worked example for available animal slurry resource in Merthyr Tydfil is shown in Table 21.

[22] http://gov.wales/statistics-and-research/agricultural-small-area-statistics/?lang=en

[23] http://gov.wales/topics/planning/policy/guidanceandleaflets/toolkit-for-planners/?lang=en

To calculate generation values, we have used the capacity factors for anaerobic digestion based on the latest regionalised load factors from BEIS[24]. For AD in Wales, these figures are currently 65 per cent for electricity generation and 70 per cent for thermal generation.

8.1.4 Poultry litter

The Welsh Government's Agricultural Land Survey (2015) figures were also used to establish farmed bird numbers in the local authority.

To calculate potential yield from this figure, we used DEFRA figures referenced in the toolkit, which suggest 42 tonnes of poultry litter per year per 1,000 birds. Of this total, approximately 75 per cent of the litter can be assumed to be available for utilisation.

Potential capacity from this yield was calculated using the assumption that about 11,000 tonnes of litter per annum are required for each 1MWe of electricity capacity[25]. Energy output from the available resource was calculated using the same capacity factors as the cattle slurry section above.

8.2 Results

It is important to be aware of the existing AD plants in adjacent authorities, as these sites already harness some of the available waste resource of the area.

Table 19: Existing anaerobic digestion projects in the surrounding area

AD sites	Location	Type	Operator	Capacity (MWe)	Feedstock
Gelliargwellt Farm (Bryn Power)	Glamorgan, CF82 8FY	Electricity Plant	Bryn Power	1.4	Agricultural, Municipal/Commercial
Bryn Pica Landfill Site (food waste)	Glamorgan, CF44 0BX	Electricity Plant	Biogen	1.2	Municipal/Commercial

8.2.1 Food waste

The supply of food waste remains fairly constant according to MTCBC Waste Strategy projections. Targets to reduce food waste combined with population growth are likely to lead to a plateau in the amount of waste generated. As discussed in the energy from waste section, Figure 28 shows a levelling of total waste quantities, with food waste included in the household kerbside recycling. Food waste collections from Merthyr Tydfil are already treated by the Biogen AD plant at Bryn Pica, therefore there is limited opportunity for further AD sites to be developed up to 2031 using food waste resource.

8.2.2 Sewage Sludge

Welsh Water plan to close all current satellite AD plants by 2020, with the aim to convert larger sites to Advanced Anaerobic Digestion (AAD). AAD significantly enhances the breakdown of organic materials resulting in a far greater conversion of organic matter into biogas compared with old AD

[24] https://www.gov.uk/government/statistics/regional-renewable-statistics
[25] http://gov.wales/topics/planning/legislation/planning-wales-act-2015/?lang=en

technology. The improved process reduces residual sludge volumes by 50 per cent and produces additional biogas/CHP derived energy, and also a better-quality bio-solids fertilizer. Welsh Water is investing heavily in projects at Five Fords WwTW near Wrexham and Cardiff & Afan WwTW, investigating the potential of ADD; they anticipate an improvement of energy yields by 30 per cent.

Sewage sludge resource up to 2031 is based on population growth figures; therefore, development of new ADD sites will focus on the most densely populated areas of Wales. Table 20, shows a worked example of the theoretical energy output from sludge resource in Merthyr Tydfil using figures from the practice guidance toolkit. This capacity will not warrant a new site in the Merthyr Tydfil area, especially as treatment facilities already exist and are being heavily developed in the surrounding area, most notably in Cardiff.

Table 20: Sewage sludge resource and potential energy outputs

Sewage sludge (tonnes)	Potential electricity capacity (MWe)	Potential heat capacity (MWth)	Annual electricity generation (MWh)	Annual heat generation (MWh)
1,861	0.14	0.21	523	1,318

8.2.3 Farm waste

As the toolkit highlights, if potential farm waste resource amounts to a potential installed capacity of less than 10MWe, it is not sufficient to support new cattle slurry or poultry litter AD plants. Both the cattle slurry and poultry litter outputs from Merthyr Tydfil are significantly below that 10MWe threshold. It is therefore more likely this resource would be combined with others to support development of AD facilities in the surrounding area.

Table 21: Cattle slurry resource and potential energy outputs

Welsh Agricultural land survey (2015)	
Total cattle (Cattle Tracing Service)	1,143
Annual cattle slurry (wet tonnes)	6,858
Available annual slurry resource (wet tonnes)	1,714.5
Potential electricity capacity - CHP (MWe)	0.008
Potential heat capacity - CHP (MWth)	0.011
Potential heat capacity - heat only (MWth)	0.036
Annual electricity generation (MWh)	43.4
Annual heat generation - CHP (MWh)	70.1
Annual heat generation - heat only (MWh)	223.7

8.2.4 Poultry litter

Table 22: Poultry litter resource

Total chickens	Poultry litter (tonnes per annum)	Potential capacity from available resource (MWe)	Annual electricity generation (MWh)
1220	38.43	0.0035	21.42

Current and projected growth of AD in the UK is slow. Across Wales the majority of developments will be farm scale, driven by farmers with capital to invest. In Merthyr Tydfil, existing waste streams are limited across all three waste streams and unlikely to warrant a new AD plant in the area.

9. E1 Task 6: Hydropower Energy Resource

9.1 Method

To assess potential hydropower sites, we used the British Hydropower Associations (BHA) hydropower resource assessment of England and Wales data to identify areas of good resource in the local authority. This type of resource assessment is very high-level and cannot consider all the constraints a site-specific assessment would examine; however, it is a good starting point for site identification. Alongside this, we analysed the Council's desk-based scoping assessment of potential hydropower sites in the County Borough[26].

9.2 Results

All the sites identified from the BHA data and the Council's own desk based scoping research can be seen in Figure 29 below. The map also shows the new community hydropower scheme in Taff Bargoed Park.

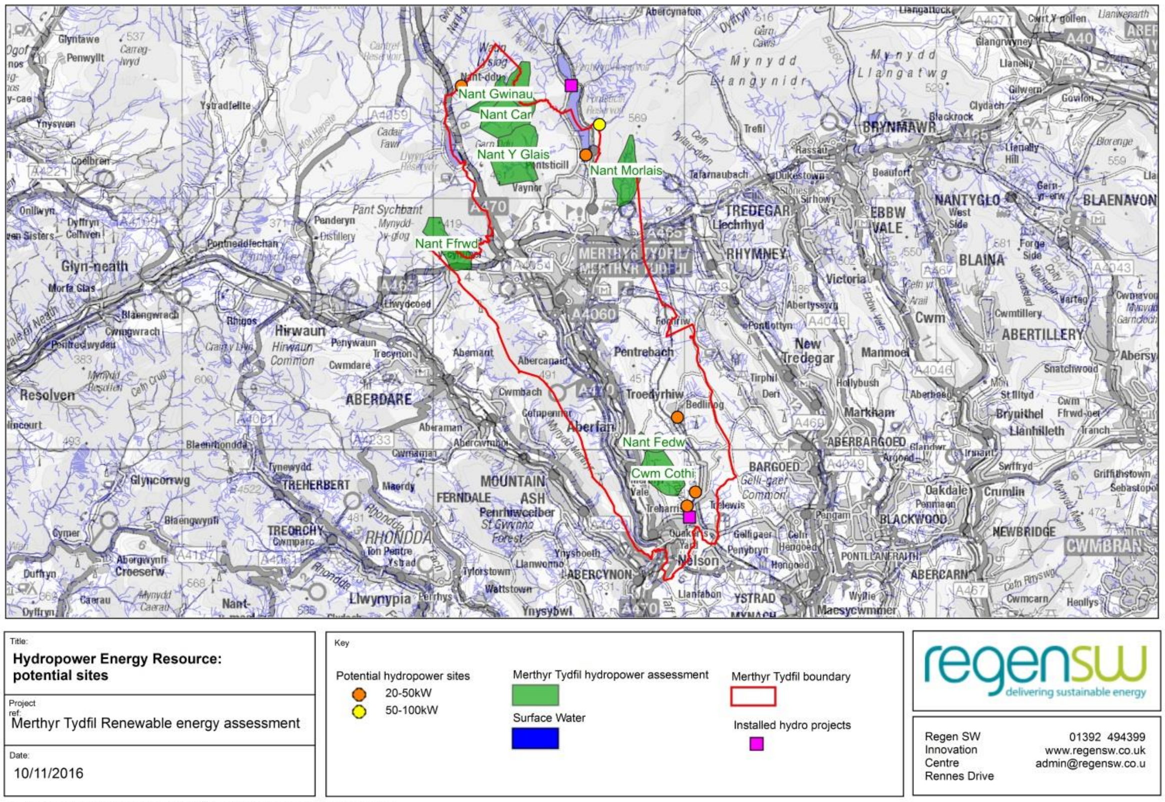

Figure 29: Potential hydropower sites

Table 23 includes six sites with the highest resource potential identified using the BHA data. Annual energy output is calculated using the regionalised load factors from BEIS, which is currently 23 per cent for hydropower in Wales.

[26] Hydro opportunities within Merthyr Tydfil County Borough, October 2014, TGV Hydro Ltd

Table 23: Potential sites for hydropower schemes

Potential hydro site	Site Reference	Feedback from progress meeting	Potential installed capacity (MW)	Potential annual energy output (MWh)
1	Trelewis		0.026	52
2	Trelewis 2		0.037	75
3	Bedlinog		0.029	59
4	Pontsticill reservoir	Brecon Beacons National Park Authority (BBNPA)	0.081	163
5	Pontsticill reservoir 2	*BBNPA	0.028	56
6	Nant-Ddu	*BBNPA	0.046	92

The Council commissioned a hydropower scoping study from TGVHydro in 2014.[27] The study identified 24 small scale sites initially and 8 schemes were deemed worthy of further viability testing.

We reviewed the hydropower scoping study with input from a senior hydropower engineer who has developed sites across the south west and Wales. The engineer's comments highlighted the current limitations to the financial viability of the sites identified. In particular, he felt that the potential income figures used (16.4p + 5.5p per kWh) were overstated in the current market, with a current maximum of 13p per kWh total at best. In addition, the assessment gives no account of operational cost (OPEX), which would be perhaps £6,000 per annum for this sort of site. As a result, the engineer felt that all the sites identified in the scoping assessment were unviable under current FIT rates. The assessment could be revisited if either costs fall or potential income rises (either through increases to the FIT or other factors such as increased costs of power). Current predictions are that these changes are unlikely in the short to medium term.

[27] Hydro opportunities within Merthyr Tydfil County Borough, October 2014, TGV Hydro Ltd

10. E1 Task 7: Large scale solar resource assessment

10.1 Method

The definition of large scale solar for this study is over 250kW in scale, in line with the Feed-in Tariff bandings, and that due to the space required for projects of this size, these would be ground-mounted rather than building-mounted.

The potential large scale solar resource in Merthyr Tydfil was assessed by mapping a number of constraints to identify areas with potential for solar parks. These constraints are listed in Table 24 and were compiled through discussions with solar developers and our experience of completing similar resource assessments for other local authorities.

Table 24: Constraints for solar assessment

Assumption	Explanation
Only areas within 2 km of the 33 kV (or higher) electricity grid lines included	Proximity to the grid reduces the cost of grid connection. High grid connection costs tend to make solar projects economically unviable.
25m buffer to houses applied	To allow for the space taken by gardens and access roads and to reduce immediate visual impact.
Designated land areas removed • **Special Protection Areas** • **Special Areas of Conservation** • **National Nature Reserves** • **Local Nature Reserves** • **Sites of Special Scientific Interest** • **Ramsar sites** • **National Parks** • **Areas of Outstanding Natural Beauty**	Solar projects can and have been built within both designated landscapes and environmental designations. However, for the purpose of this resource assessment, these areas have been removed.
Agricultural land grade 3 or above removed	Grades 1 and 2 are the best and most versatile for food production, however, there is no land of this grade available in MTCBC
Urban and other developed land (housing and industrial areas) removed	It is unlikely that there will be space for ground-mounted solar. However, open spaces were included.
Physical constraints	Roads, woodland, rivers and water bodies where development is generally not feasible.

Unfeasible land such as very steep slopes was removed	Solar farms are most suitable where topography is relatively flat to minimise visual impact and access issues. The following limits were used: • Inclinations of 0-3°, all orientations can be considered • Between 3-15° only south-west to south-east facing areas • All slope above 15° was removed as a constraint

As well as considering the constraints listed above, we mapped and considered the implications of proposed new residential and non-residential development areas, as there may be synergies between these areas, for example through private wire opportunities.

10.2 Results

Figure 30 shows the extent of the potential large scale solar resource area available. The areas identified are those that remain unconstrained, once all the constraints listed in Table 24 have been applied; an area totalling 8.4 km².

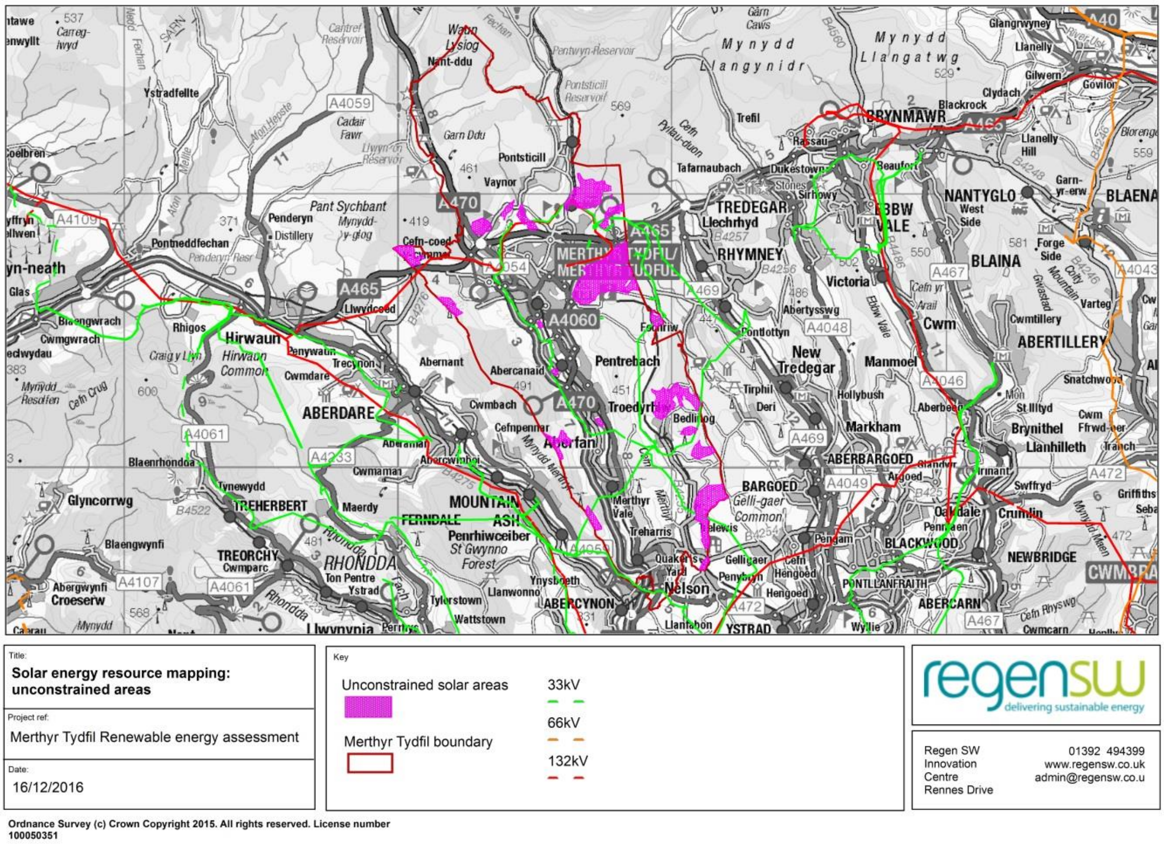

Figure 30: Area with potential for solar parks

The areas identified are not definitive due to; the relatively high-level nature of a resource assessment, some sites with potential may come forward outside of the areas and solar development in the areas themselves will depend on solar developers, landowners or communities identifying potential projects following more detailed site-specific analysis.

10.2.1 Cumulative impact

As with wind, cumulative impact can only truly be considered on a case by case basis, but will be assessed in part through the Sustainability Appraisal of the Local Development Plan. For Merthyr Tydfil, the unconstrained area is already small, due mainly to the topography of the area, but in order to consider cumulative impact, we have limited the number of solar farms to 3 PV farms within a 10 km^2 area. As the majority of the resource is distributed around the edges of the local authority boundary, once this factor was applied to the total available resource (8.4 km^2), a total suitable resource area of 6.4 km^2 remained.

An installed capacity density factor of approximately 1 MW per 0.024 km^2 was assumed based on the toolkit recommendation's which use the DECC UK Solar PV Strategy Part 1: Roadmap to a Brighter Future[28].

We have not considered grid constraints in assessing the maximum potential resource, but have considered them as a factor in recommending a renewable energy target (Section 16 - P1).

Table 25: Results of ground-mounted solar resource assessment

Unconstrained area	Cumulative impact applied	Final potential capacity
km^2	km^2	MW
8.4	6.4	267

10.3 Next steps

This resource assessment is useful to understand and inform debate on the potential for ground-mounted solar in Merthyr Tydfil. It demonstrates that there are areas of land with potential for solar and that these have not yet been developed.

The maximum resource potential is used in the analysis in sections P1, P2, P3 and P4 to further inform site allocations and identify specific opportunities.

The mapped areas are also useful to prompt landowners and communities to think about whether there are opportunities for solar on their land, or in their area. The information in these maps could inspire landowners and local communities to look in more detail for opportunities in their area.

[28] http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249277/UK_Solar_PV_Strategy_Part_1_Roadmap_to_a_Brighter_Future_08.10.pdf

11. E2 Building integrated renewables uptake assessment

11.1 Method

We have developed a model to estimate the potential uptake of building integrated renewables to 2031. The model is based on National Grid's four future energy scenarios: Gone Green, Consumer Power, Slow Progression and No Progression. The features of the scenarios are set out in Section 3.1 above. This is a slightly different approach to assessing the resource than used with other technologies, where we have looked at maximum theoretical potential. Using scenario analysis, we have been able to predict more realistically how much of the resource would be harnessed under certain economic and political conditions.

The assessment analyses uptake of three small-scale building integrated technologies: solar PV, heat pumps and biomass. Solar thermal and building mounted wind are not accounted for in the assessment, as our market insight suggests limited opportunities for these technologies. The model is split to cover both the new build and existing (retrofit) sectors, as the drivers for deployment are different between the two. New build installations are driven by local planning policy, Welsh building regulations and market opportunity for developers. Retrofit installations are driven by consumers' willingness to invest.

Figures for the number of new homes added each year are based on the house building scenarios provided by MTCBC. The higher economic scenarios, Gone Green and Consumer Power use the highest realistic build out rate (Scenario 2: Dwelling led scenario – past 15-year build rate) as recommended by the Council. The Slow Progression and No Progression annual build out rates are then staggered to reflect a poorer economic climate. These housing figures could be updated over time to accurately reflect development in the area.

For each technology, the capacity projections are based on the existing baseline installed in the Merthyr Tydfil area, as of December 2016. From this baseline figure, future growth is projected out to 2031 and considers a variety of local and national factors which can contribute to overall installation rates. These factors are described below for each technology under the four future energy scenarios.

The scenarios are for building integrated deployment, which could be domestic or small-scale commercial, or on public buildings. We have used an assumed installed capacity, based on average installations. We have also calculated the equivalent proportion of homes that would have a system in order to help communicate the scale of opportunity, however, in reality this deployment would be across domestic, commercial and public buildings.

11.2 Results

The spreadsheet model for building integrated renewables uptake in Merthyr Tydfil has been given to the Council with accompanying guidance notes. Figures can be updated as annual housing numbers and average installation capacity change over time.

The considerations for each technology under the four scenarios are discussed below, with figure outputs showing anticipated future trends.

11.2.1 Solar PV

Scenarios summary for roof-mounted solar PV	
Consumer Power • High growth scenario • Rooftop installation rates rise through the decade as costs fall, with the proportion of solar PV installations with storage increasing. • For new homes, the impetus for installations is driven by consumer demand for high tech properties; this leads to growth through the decade, with high installation rates achieved by the end of the decade.	**Gone Green** • Highest growth scenario • Rooftop installation rates rise through the decade as costs fall, with the proportion of solar PV installations with storage increasing. • Around 9 per cent of all existing homes have solar by 2031 • A large proportion of new homes include PV due to planning requirements.
No Progression • Lowest growth scenario • Poor planning and economic environment • Some municipal and community schemes installed but otherwise rooftop schemes are relatively limited.	**Slow Progression** • Low/medium growth scenario • Widespread price parity reached and impacting around 2024/25 for small scale – overall around 40 per cent fewer rooftop projects than under Gone Green • A large proportion of new homes include PV due to planning requirements – but fewer new homes built than under Gone Green.

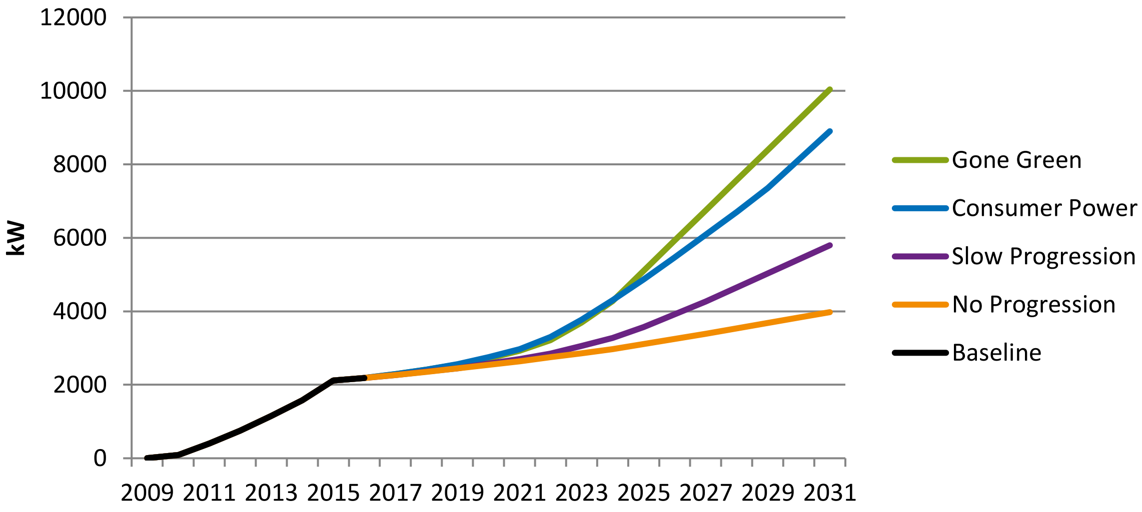

Figure 31: Projected growth scenarios of rooftop solar PV capacity in Merthyr Tydfil

	Installed capacity (MW)	Number of installations	Equivalent proportion of homes (%)
Gone Green	10	2,953	11
Consumer Power	9.5	2,618	10
Slow Progression	5.9	1,705	6
No Progression	3.8	1,170	4

Table 26: Growth of rooftop solar PV to 2031

These results are based on an assumed average capacity of 3.4kW per project.

11.2.2 Heat Pumps

Heat pumps scenario summary

Consumer Power

- High growth scenario
- Demand is from private consumers rather than public sector
- Deployment reaches a tipping point and market awareness increases rapidly
- Rate of new build increases dramatically as consumers increasingly want efficient, low carbon buildings
- Demand for cooling requires reversible systems
- Demand for grid stabilisation technologies enables development of consumer market
- Rapidly decreasing prices for PV systems resulting in more integrated systems
- Some take up in on-gas areas
- Self-build market grows strongly
- No higher energy standards for new builds
- Costs fall as R & D improves the technology and reduces the price.

Gone Green

- Highest overall growth scenario
- Positive planning environment with Welsh Government/ the Council introducing higher energy standards for new buildings and enforced renovation of old buildings
- Government incentives to install heat pumps stimulate demand
- Dynamic grid developed with payment systems for those able to take energy off the grid and store
- Cost of energy increases resulting in increasing viability of applications (heat networks, waste heat capture)
- Substantial take up in on-gas areas
- Housing associations and public sector roll out investment programmes, alongside higher private demand
- Costs fall as R & D improves the technology and reduces the price.

No Progression

- Lowest growth scenario with similar deployment figures to current trends
- No higher energy standards for new homes and fewer new build properties
- Retrofit growth remains in the 'able to pay' sector, with few consumers having the available capital

Slow Progression

- Medium growth scenario
- Positive planning environment with Welsh government or the Council introducing higher energy standards (but fewer new homes are built) and enforced renovation of old buildings

- Cost of key components increases, stifling technology development
- Heat network development focuses on gas and biomass combined heat and power systems only
- RHI continues until 2018 but is then cut or stopped.

- Social housing cuts result in reduced demand from this sector
- Energy prices stay low
- Government incentive made available but less uptake as fewer consumers can afford the investment
- Retrofit growth remains in the 'able to pay' sector, with fewer consumers having the available capital
- Cost of key components increases, stifling technology development.

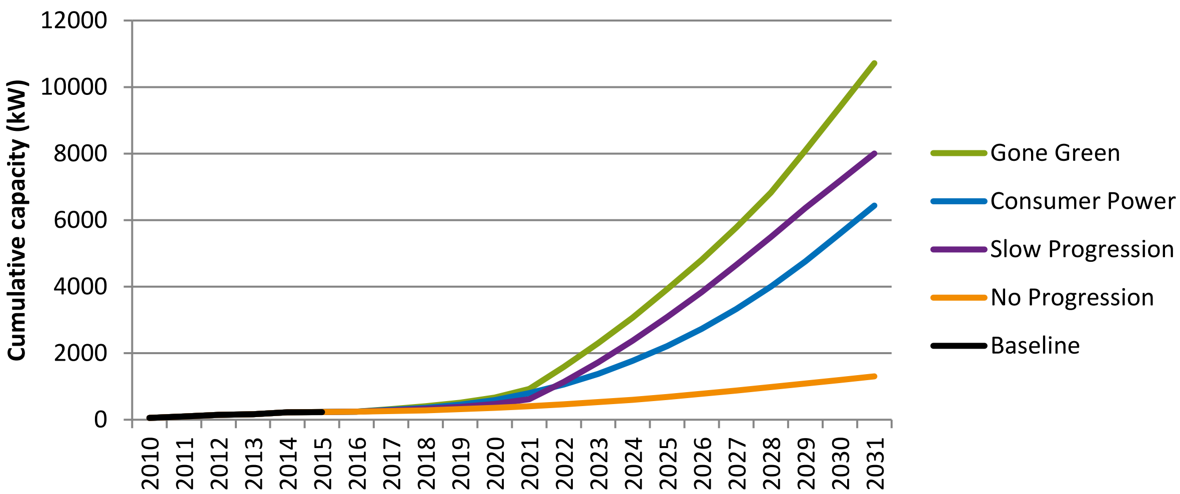

Figure 32: Projected growth scenarios of heat pump capacity in Merthyr Tydfil

Table 27: Growth of heat pumps to 2031

	Installed capacity (MW)	Number of installations	Equivalent proportion of homes (%)
Gone Green	10.7	1,020	4
Consumer Power	6.4	613	2
Slow Progression	8	762	3
No Progression	1.3	124	0.5

We have assumed an average installed capacity of 10.5 kW.

11.2.3 Biomass

Biomass scenario summary	
Consumer Power • High growth scenario • Technological innovation and fuel cost reductions • Lower new build deployment due to a lack of higher energy standards • Higher proportion of retrofit projects.	**Gone Green** • High growth scenario • Higher installations in new build due higher energy standards introduced by the Council or Welsh Government • Increased retrofit installations.
No Progression • Lowest growth scenario • Poor economic environment • Cost and effort of retrofit biomass would result in very slow growth.	**Slow Progression** • Medium growth scenario • Positive planning environment • But poor economic and finance outlook meaning a lack of investment capital available • Projects focussed within the limited off gas housing stock.

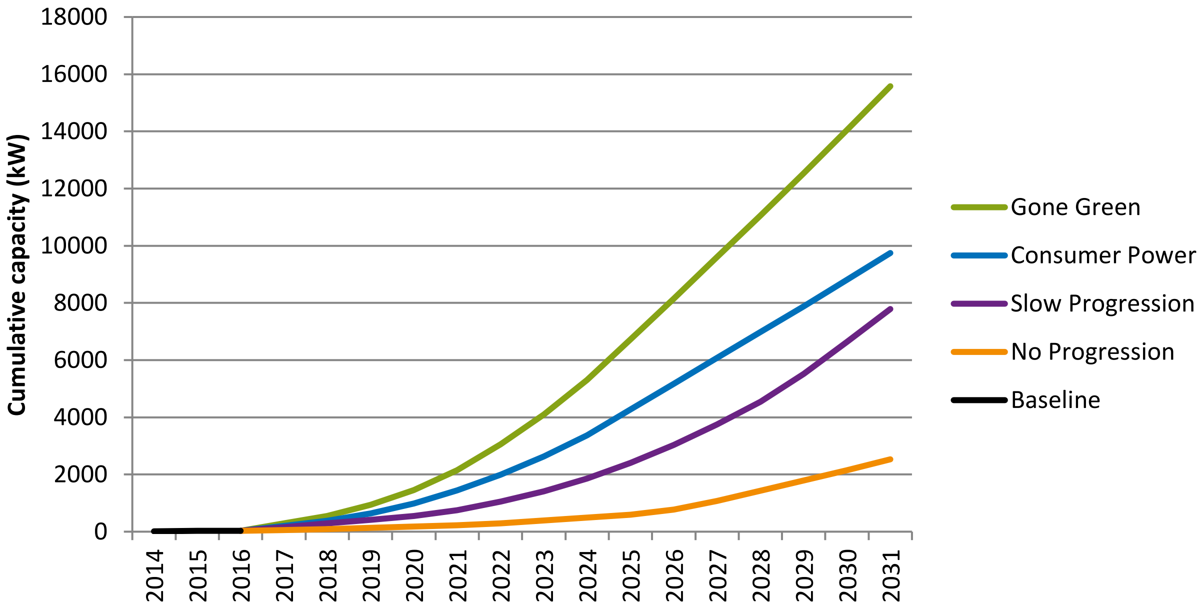

Figure 33: Projected growth scenarios for small scale biomass capacity in Merthyr Tydfil

Table 28: Growth of small scale biomass to 2031

	Installed capacity (MW)	Number of installations	Equivalent proportion of homes (%)
Gone Green	15.6	916	3
Consumer Power	9.8	573	2
Slow Progression	7.8	458	2
No Progression	2.5	149	0.6

These results are based on an assumed average installed capacity of 17kW.

12. E3 Heat opportunities mapping

12.1 Method

To identify opportunities for heat networks, we have identified where clusters of non-residential heat demand, known as 'anchor loads' are in close proximity to social housing, or areas of regeneration. This combination of building types can often provide one of the most economically viable scenarios for a heat network. The anchor loads themselves are typically buildings that have high heat demands, either at a fairly constant rate, or outside the residential peak demand times of 7-9 am and 5-8 pm.

We broadly followed the process for identifying heat network opportunities as outlined in the *'Planning for renewable and low carbon energy toolkit'*, but considered some additional factors set out in the process below:

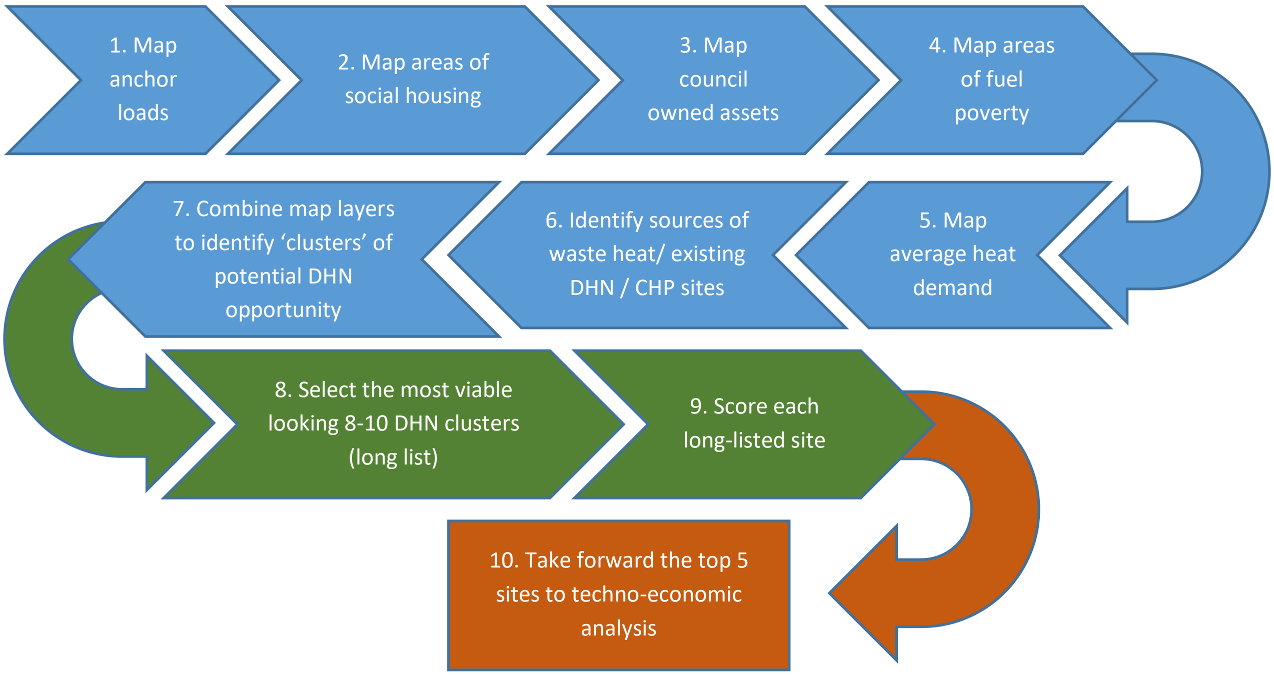

Figure 34: Process diagram for identifying heat opportunities

Once potential clusters of social housing and anchor loads had been identified, the long-list of opportunities were further narrowed by examining the features of heat networks that could affect their viability, including:

- the availability of Council owned land for building energy centers
- the level of fuel poverty in the local residential areas
- 'cost escalators', such as network pipes having to cross key highways, rail routes or water courses
- proximity to sources of waste heat, that could feed the heat network

The factors above were considered for each of the initial clusters, resulting in a 'long-list' of the clusters that appear to have the best conditions for a heat network. This long-list was then scored to narrow the field to the most comparatively viable sites in the County Borough. The scoring matrix can be seen in Appendix A.

12.2 Establish anchor loads

We mapped the following key sources of non-residential heat demand (anchor loads) that can help establish a viable heat network. Specifically, we identified the following sites in the area, using Ordnance Survey Address-point data provided by MTCBC:

Hospitals	Museums
Care homes	Offices
Factories and manufacturing	Power stations / energy production
Colleges	Primary schools
Fire, Police and ambulance stations	Secondary schools
Law courts	Theatres, arenas, stadia
Leisure centres	Water / sewage treatment works
Libraries	

Whilst not necessarily exhaustive, the list above covers the majority of buildings that could have heat demands high enough to be considered as 'anchors' for a heat network. Some smaller loads such as children's nurseries and health clinics were removed from this list if they were not in close proximity to a much larger load. This is because although they could provide a useful non-residential demand profile, they would be unlikely to be big enough to provide a DHN anchor load in their own right.

As can be seen from the map in Figure 35 and Figure 36, anchor loads of varying type and size can be found throughout central and southern areas of MTCBC.

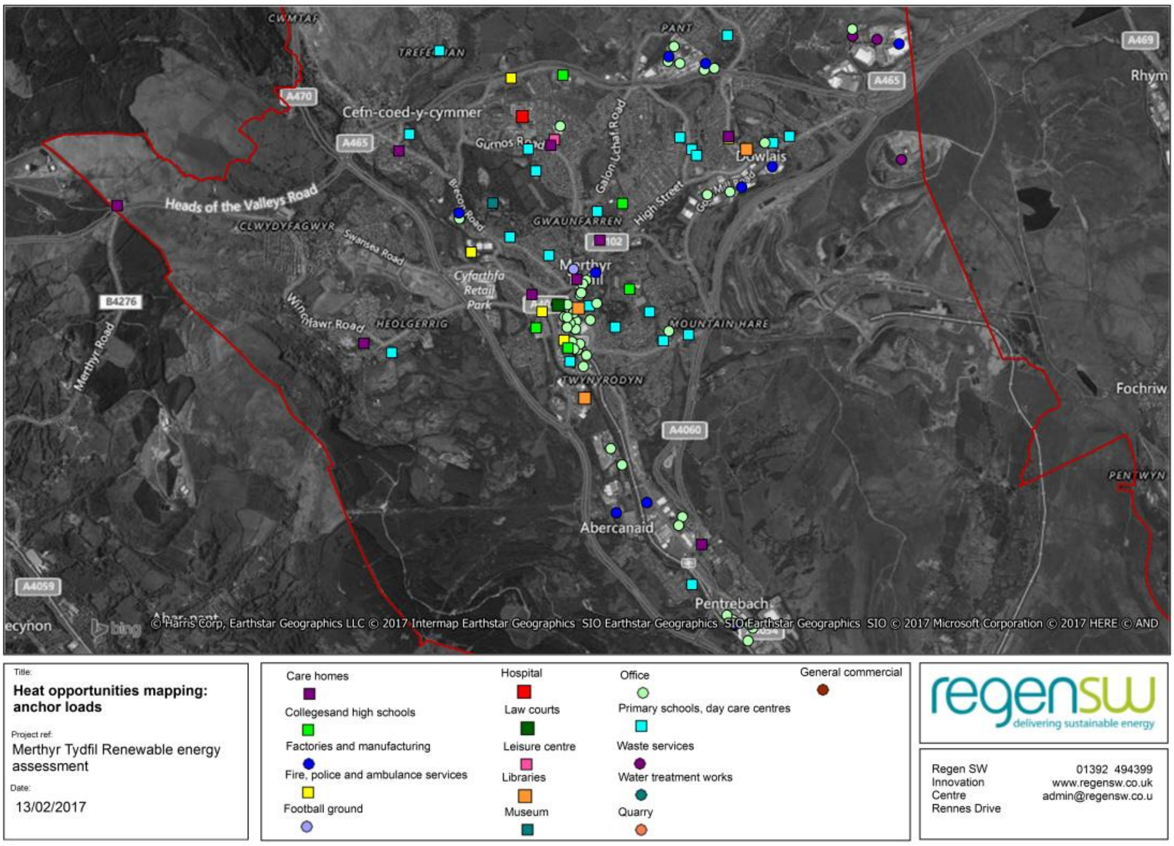

Figure 35: Locations of key anchor loads as identified through OS Address-point (North sheet)

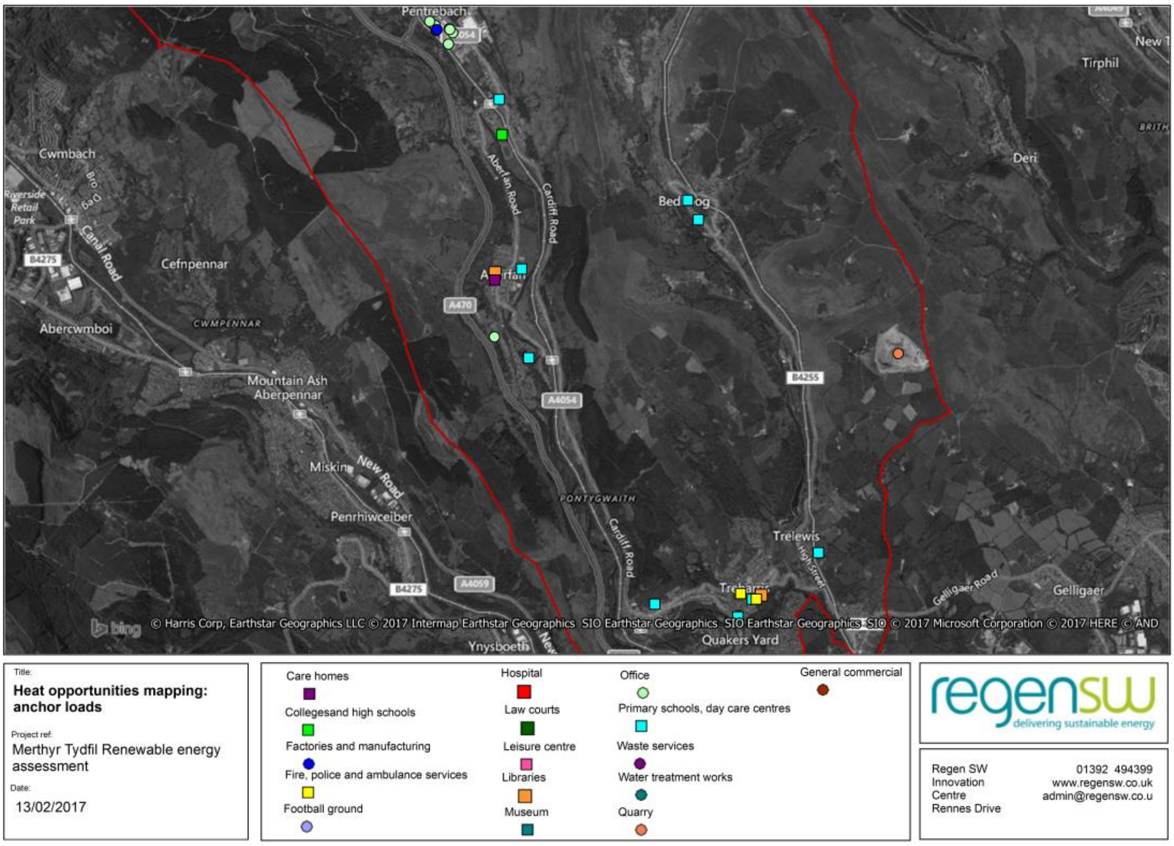

Figure 36: Locations of key anchor loads as identified through OS Address-point (South sheet)

Alongside the anchor loads, there is scope for general commercial, factory and manufacturing plants to play a role in the viability of heat networks. These additional demands can have a wide range of energy demands, which are not necessarily straightforward to establish at the opportunity mapping stage. In addition, ownership and leasing around non-domestic sites can be complex and adds additional risk to a potential project. If anchor loads can be established that are based on public sector organisations (such as hospitals and schools), this can offer a more secure footing. However, when examining the anchor loads and social housing clusters, having some additional private sector non-residential demand close by adds potential flexibility. For this reason, sites with private sector non-residential demand close by (such as industrial estates), were given higher priority than those without when selecting the long-list.

The next stage was to look at each anchor load and establish how significant it is, and what other demands were close by.

12.3 Identify social housing

Social housing often features in retrofit heat networks for a number of reasons:

- single ownership of many housing units, generating substantial demand
- the owner can invest in connecting to the network, rather than a number of owner/occupiers having to
- social housing units are often built in relatively high density clusters
- additional benefits are valued by social landlords, such as carbon savings and the potential to reduce fuel poverty if bills can be reduced.

For these reasons, social housing was used a key feature in identifying heat opportunities in Merthyr Tydfil. By taking the output of step 1 (identification of significant anchor loads) and overlaying the areas of social housing, potential areas of interest begin to emerge, as can be seen below in Figure 37: Locations of key anchor loads and social housing as identified through OS Address-point.

Social housing sites that were not in close proximity to potential anchor loads were dismissed.

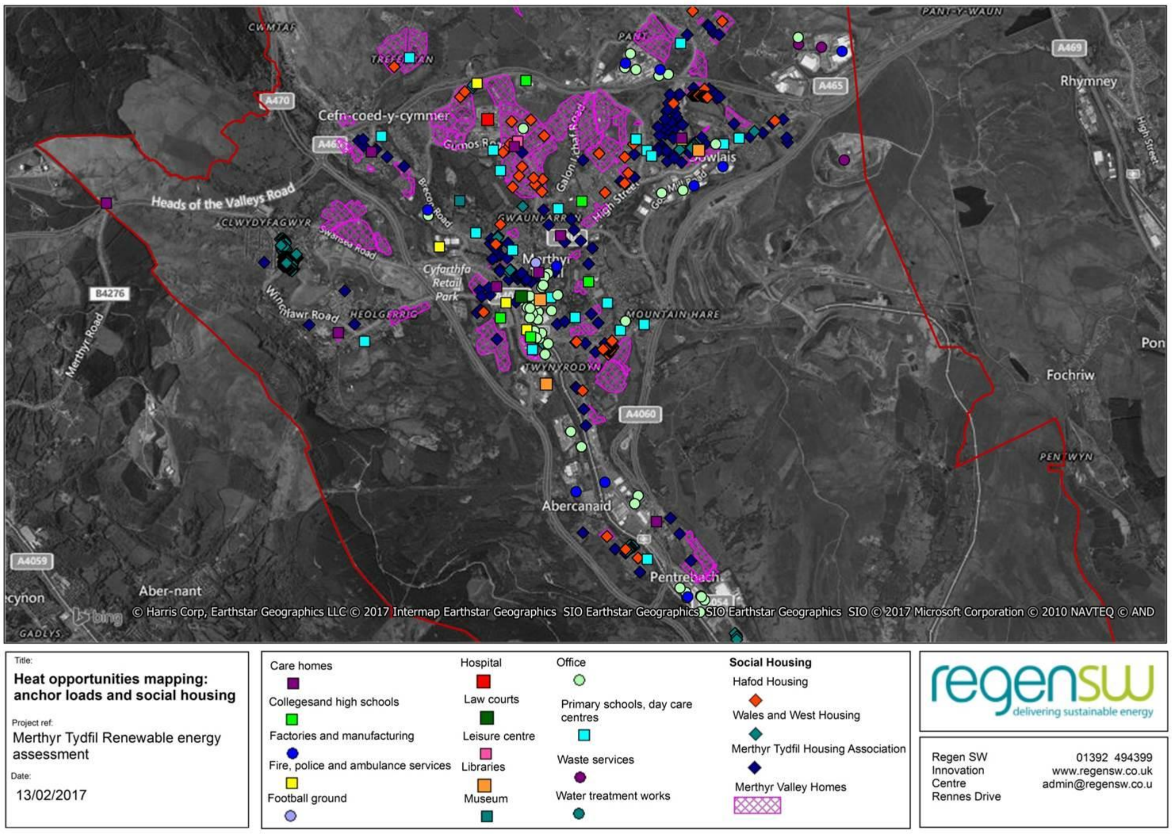

Figure 37: Locations of key anchor loads and social housing as identified through OS Address-point

12.4 Council owned assets

Establishing areas where anchor loads and social housing are in close proximity generates a relatively large number of opportunities. The list was then further prioritised by establishing which opportunity areas could feasibly have energy centres built, a key requirement of any district heat network. For the purposes of this study, we examined which anchor load/social housing sites also had Council owned land close by, *or* could feasibly repurpose an existing energy centre.

Typically, Council owned assets near to anchor loads are tracts of unimproved land or schools. These sites can offer good locations for energy centres, as the land can be made available more easily than land held in private hands. The exception to this is where the anchor load itself is sufficiently large to already have its own energy centre, or encompasses enough of a footprint to accommodate one, such as hospitals and factories.

12.5 Areas of fuel poverty

Heat networks can, in the right circumstances, offer a route to addressing fuel poverty in low income households. However, the role they can play in reducing heating bills in homes already connected to the gas grid (and therefore consuming one of the cheapest heating fuels) is often overstated. In this scenario, a heat network can be valuable to provide long term visibility of heating costs, especially if there is an interest from the local authority in providing the energy supply.

For this reason, an assessment of the proportion of homes listed as being in fuel poverty was not used to establish viable heat clusters, but has been included in the scoring process of long-listed areas.

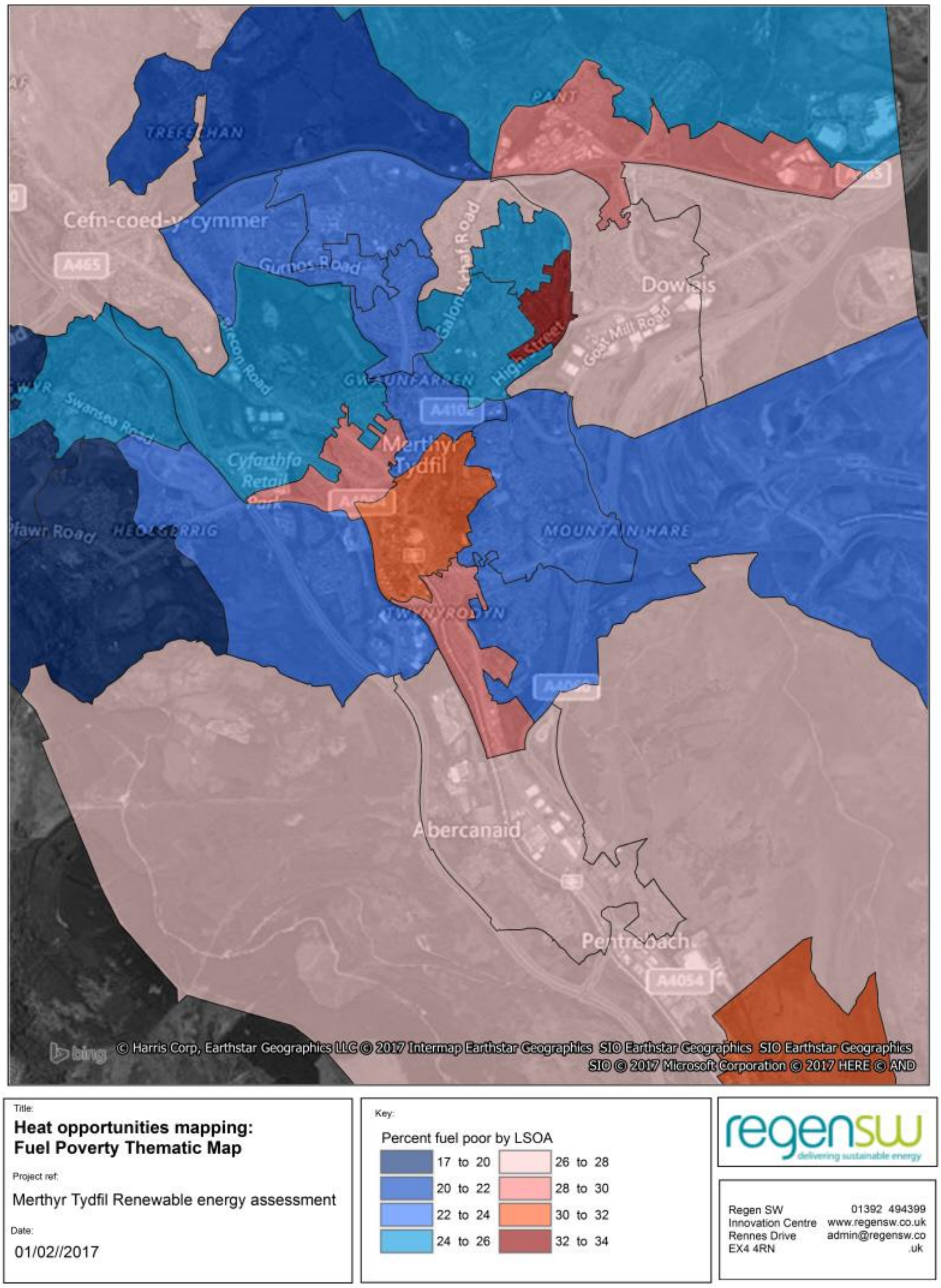

Figure 38: Fuel poverty (per cent fuel poor by Lower Super Output Area)

12.6 Average heat demand

There are two routes to establishing the density of heat demand in residential housing:

1. Examining the individual house types and their typical heat loss values
2. Using heat demand data sets to ascertain total heat demand in the output area

For the purposes of this study, we were primarily looking at social housing clusters. To model the heat demand associated with social housing, we estimated the number of homes in each cluster and multiplied this by the 'notional home' demand (see section 13 for details on calculating the energy demand of a 'notional home').

As mentioned previously, it was the presence of social housing that was used to highlight potential heat network opportunities, rather than the overall heat demand of that output area.

However, comparing the heat demand shown in the thematic maps for each long-listed area helped validate the level of residential heat demand.

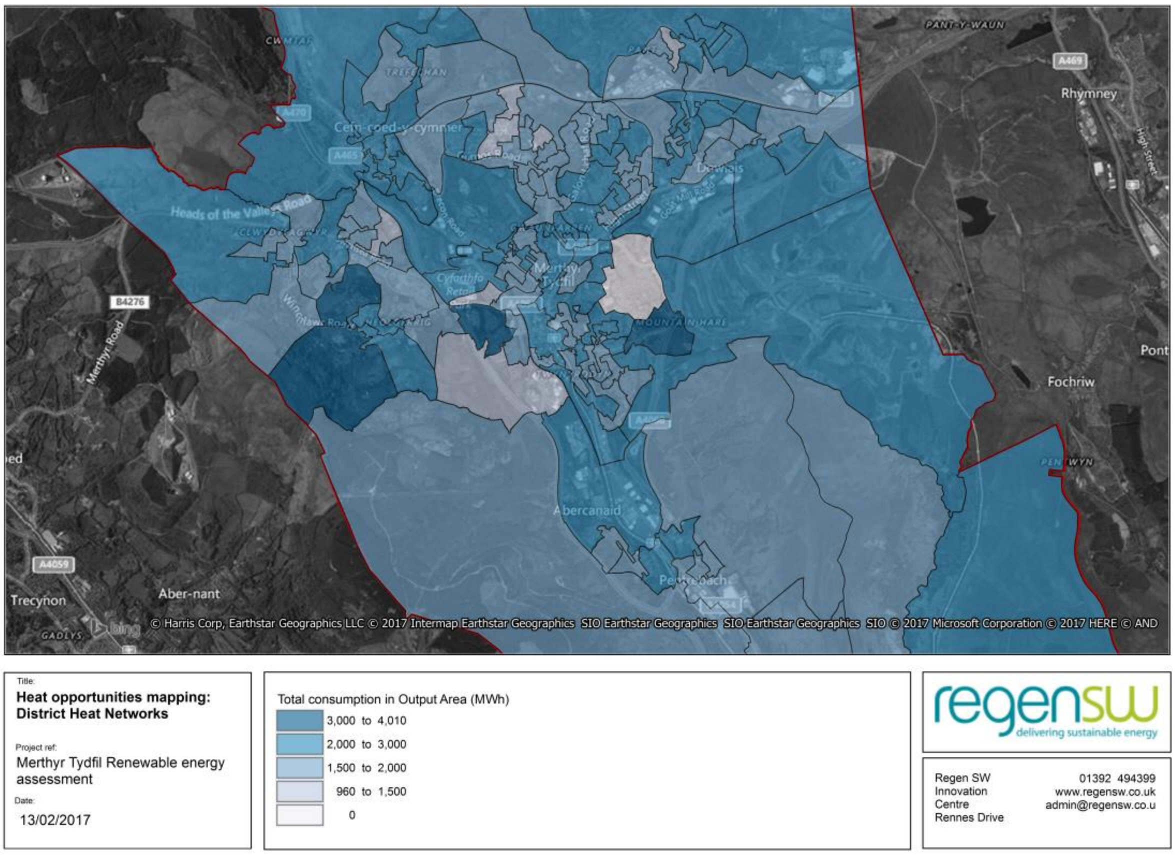

Figure 39: Average consumption in output area (MWh/yr) North sheet

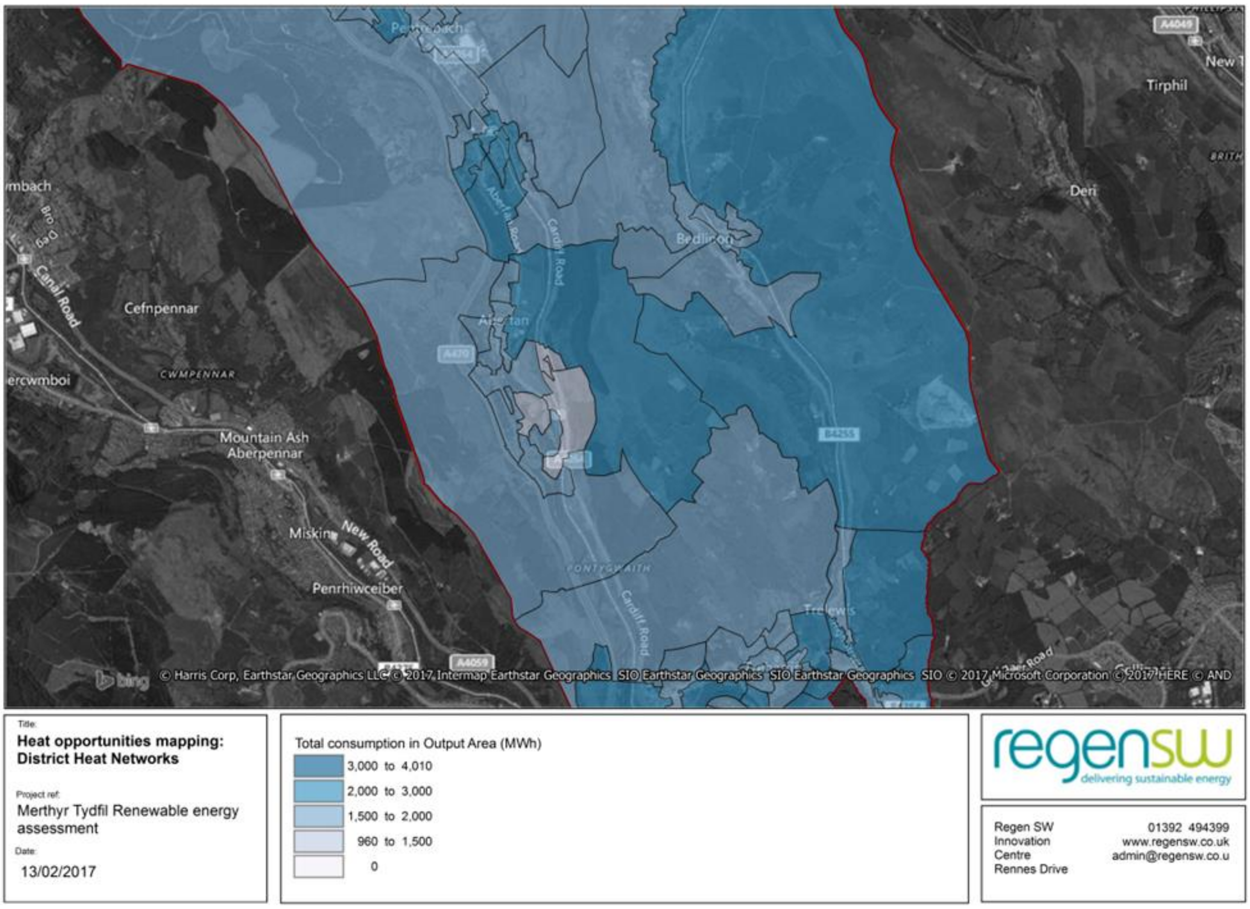

Figure 40: Average consumption in output area (MWh/yr) South sheet

12.7 Identification of sources of waste heat

We assessed the Merthyr Tydfil area for potential sources of waste heat. To the best of our knowledge there are no major sources of *waste* heat in the vicinity, certainly none that may be significant or accessible enough *and* in close enough proximity to provide heat to local demands. The exception to this may be the river Taff, which could in theory provide the energy for a water source heat pump.

12.8 Potential development areas considered

Large sites offer a good opportunity to consider heat networks, as the traditional connection costs for individual gas boilers can be avoided, and carbon emissions reduced. Three large potential development areas in Merthyr Tydfil were assessed for their potential heat (and electricity) demands in section 13:

- Project Heartland (the former Ivor Steel Works)
- Goat Mill Road
- Hoover factory / Dragonparc

Each of these areas was considered alongside retrofit opportunities identified in steps 1-6 outlined earlier. In all cases, the location of the potential development areas was sufficiently close to existing anchor loads and/or social housing to support the assessment of a wider scheme and inclusion as a potential cluster. This meant that each area was taken forward to the scoring phase.

It should be remembered that new build sites do offer a very different model for heat networks, as many costs can be avoided or mitigated by planning for the network early.

We have kept our assessment focused on the relative merits of what building archetypes and their scale are planned for each area, rather than the difference in build cost between new-build and retrofit. Where large developments were taken forward to techno-economic analysis, this difference in cost was accommodated by reducing the amount of pipework assigned to the opportunity area, thus reducing CAPEX.

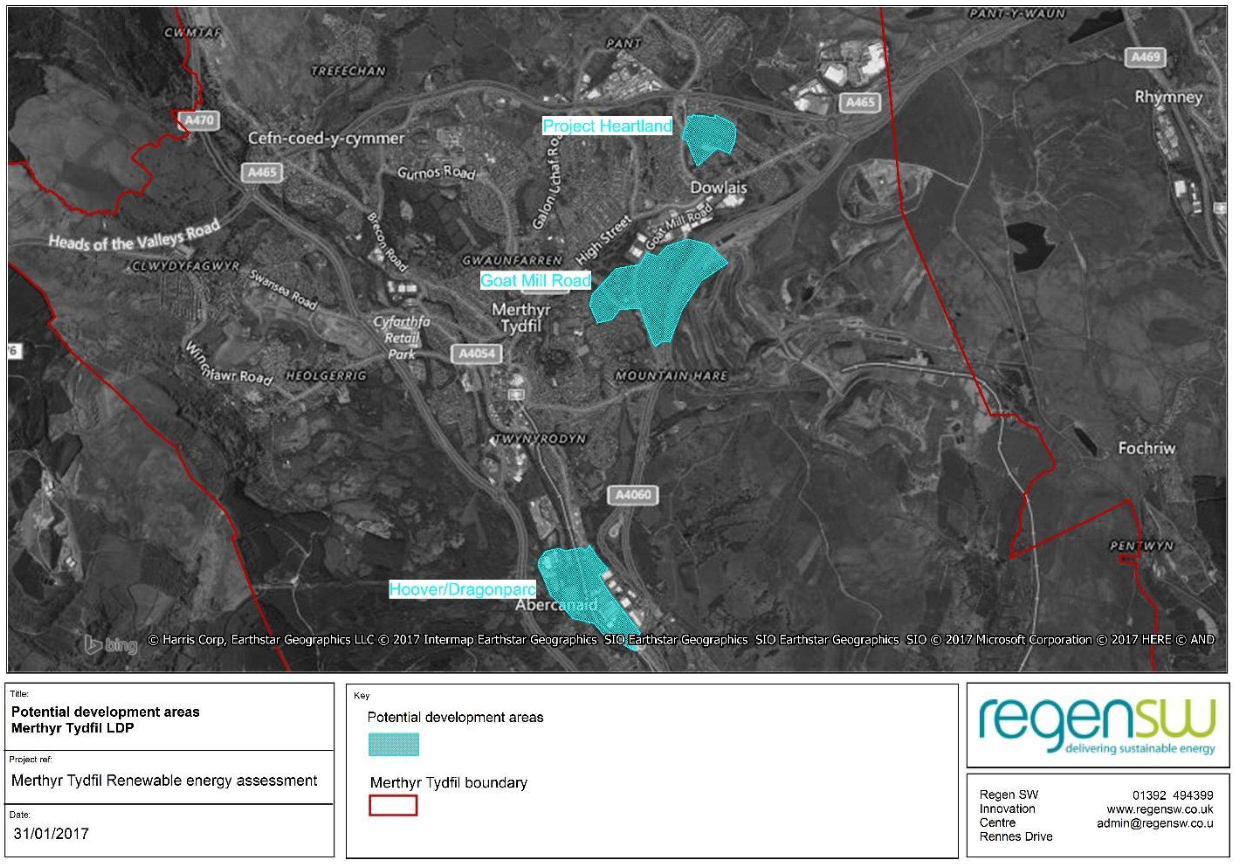

Figure 41: Locations of the potential development areas considered as part of this study

12.9 Long list of opportunities

As outlined at the beginning of the section, Figure 37 shows the relationship between anchor loads as identified by Address-point data and areas of social housing.

We applied the following logic to either include or exclude the cluster from further analysis:

- Is the anchor load significant compared to the number of social housing units close by?
- Are the social housing units in close proximity to the anchor load?
- Are there any obvious complications to the likely pipe route, such as railway lines, major roads or watercourses?
- Is there sufficient space that could host an Energy Centre?
- Is there land owned by an interested party (anchor load owner or the Council) that could be used for pipe runs or the location of the energy centre?

- Are there any new developments or areas of regeneration in planning nearby?
- Are there any sources of waste heat nearby?
- Are any of the anchor loads or residential areas to be served off the gas-grid?

We looked at each anchor load (or small cluster of anchor loads) in Merthyr Tydfil and were able to discount many of them as being either too small, of unknown size or simply too far from other demands to be of value. In this way, we reduced the total number of anchor load-led opportunities to just eight that could conceivably support a heat network:

Table 29: Opportunities for district heat networks

Area ref	Area name	Key anchor loads
Area number 1	Prince Charles Hospital + Project heartland	Prince Charles Hospital Pen-Y-Dre High School Dowlais Library Pant Industrial estate (unknown loads)
Area number 2	Goat Mill Road	OP Chocolate Factory S&G Print Group Cords Duaflex
Area number 3	Bishop Hedley	Bishop Hedley Catholic High School Gwaunfarren Primary School Penydarren Social Club
Area number 4	Cyfarthfa High School	Cyfarthfa High School Ysgol Gymraeg Santes Tudful
Area number 5	High Street	Tesco Merthyr Tydfil Magistrates Court Merthyr Tydfil Central Library The LoadLok Community Stadium
Area number 6	Caedraw Road	Caedraw Primary School The College Merthyr Tydfil
Area number 7	Hoover/Dragonparc	Kasai Factory Merthyr Tydfil Institute for the Blind Amnitec Greenhill Manor Care Home - Hallmark Care Homes Merthyr Tydfil County Borough Council offices
Area number 8	Merthyr Road	Linde Industrial Park / Merthyr Tydfil Industrial Park

This long list simply represents clusters of heat demand that would appear from our mapping analysis alone to offer some level of heat network opportunity. At this stage, none of the anchor loads has necessarily been fully identified or quantified beyond appearing in Address-point data.

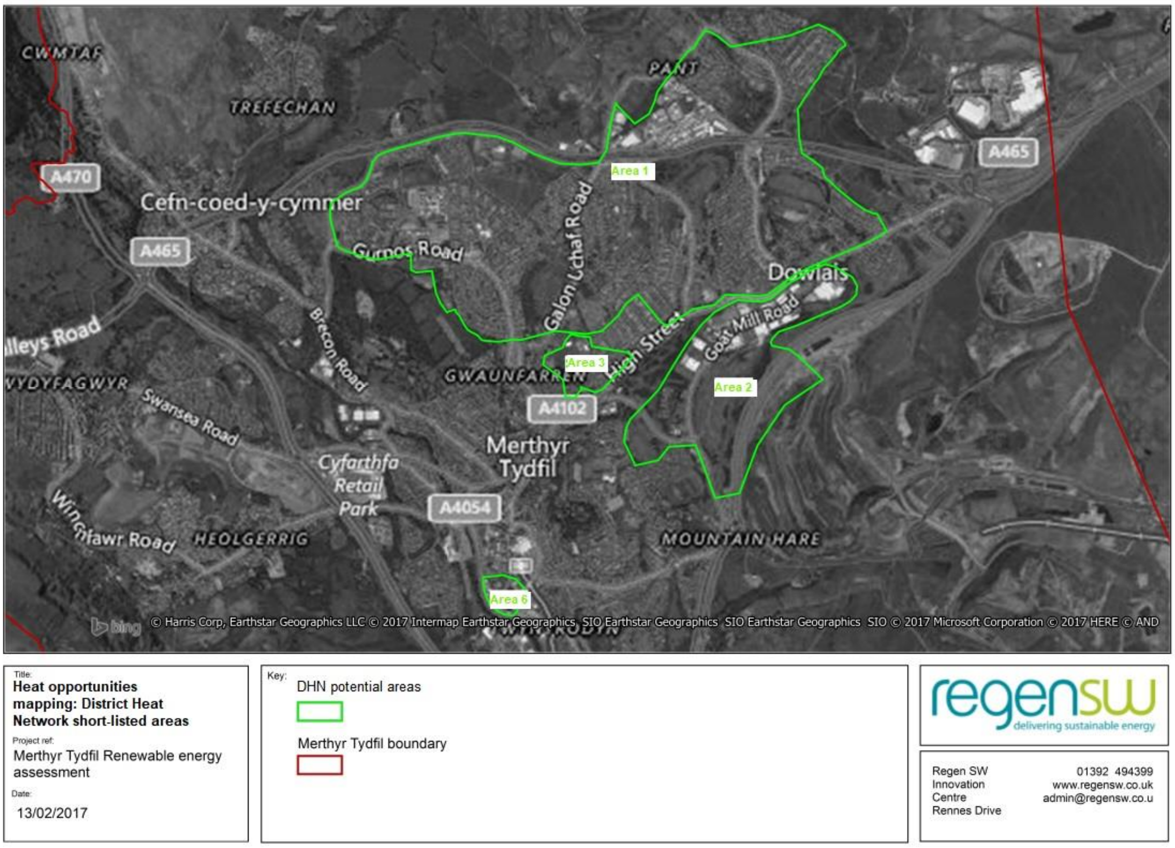

Figure 42: Locations of long-listed opportunities (North sheet)

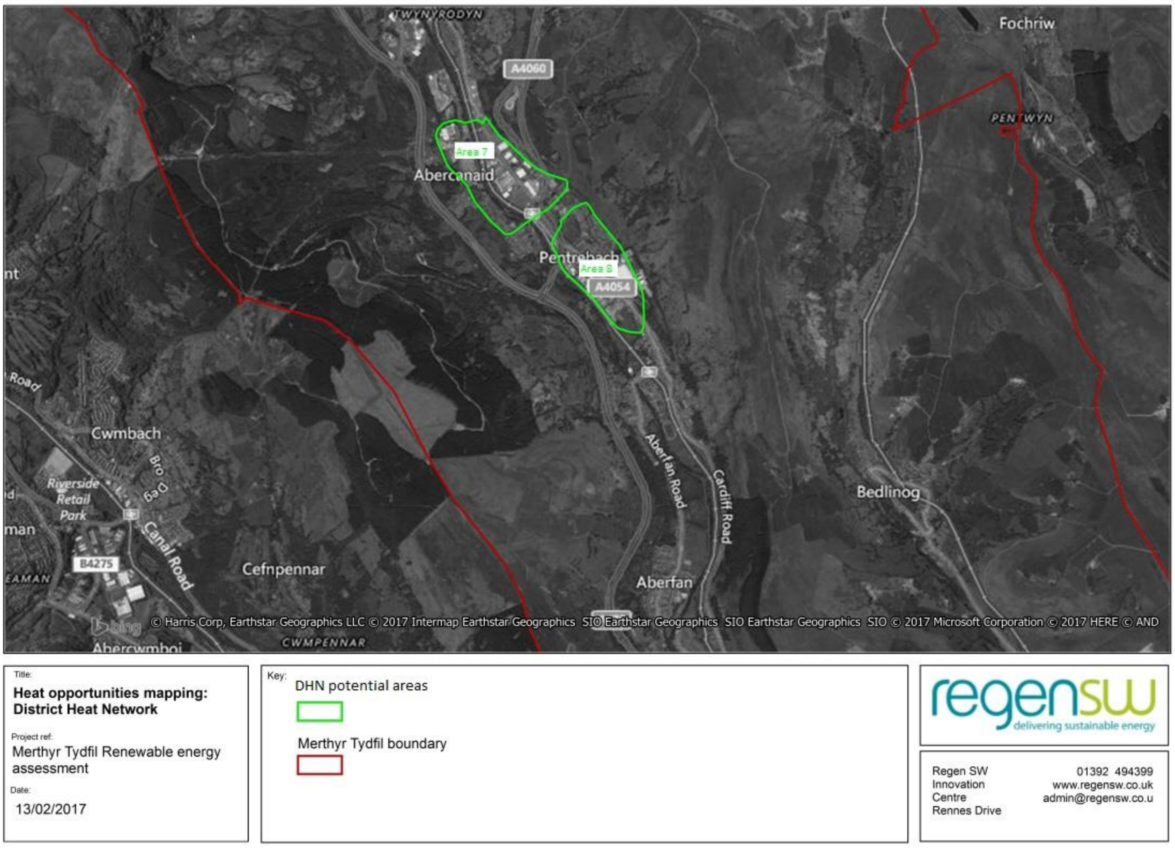

Figure 43: Locations of long-listed opportunities (South sheet)

Scoring

Using the scoring matrix found in Appendix A – Area scoring for DHNs, this long-list of opportunities was assessed and reduced to just 5 areas for further techno-economic modelling. The results of the scoring process are:

Table 30: Results from scoring process

Area name	Score	Ranking
1 - Prince Charles Hospital/Project Heartland	227.8	1
6 - Caedraw Road	220.6	2
3 - Bishop Hedley	211.2	3
2 - Goat Mill Road	196.5	4
7 - Hoover/Dragonparc	186.1	5
8 - Merthyr Road	165.8	6
4 - Cyfarthfa High School	154.1	7
5 - High Street	116.4	8

The top five opportunities based on the scoring process are examined further in section 15. Technical and economic feasibility of DHN was therefore undertaken on:

- Area 1: Prince Charles Hospital/Project Heartland
- Area 6: Caedraw Road
- Area 3: Bishop Hedley
- Area 2: Goat Mill Road
- Area 7: Hoover/Dragonparc

13. E4 Task 2: Assessing energy demands of potential development areas considered as part of this study

The three potential development areas are shown in figure 44 below.

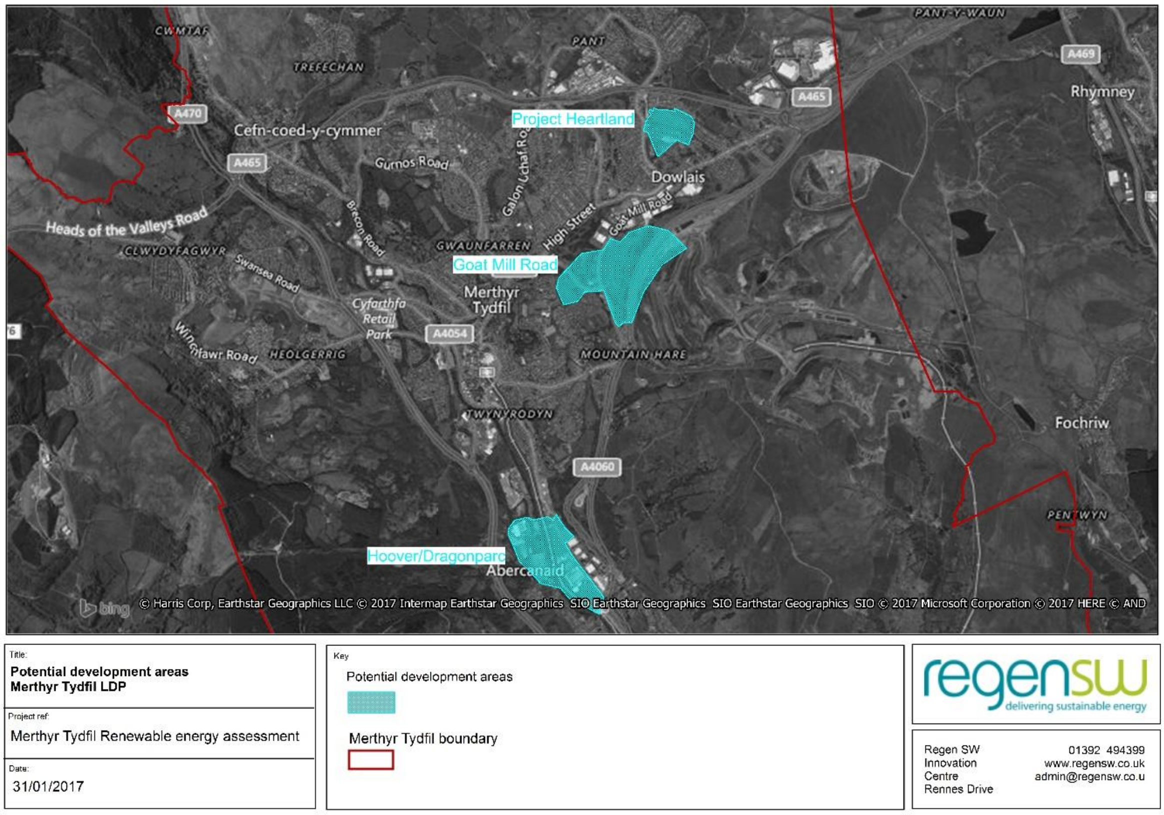

Figure 44: Location of potential development areas considered as part of this study

For the Goat Mill Road and Hoover factory/Dragonparc potential development areas, assumptions for commercial development have been made on the basis that the area has been earmarked in the LDP as being 'B2' land use: general office, light industrial and workshops.

13.1 Method

To assess the potential energy demand of each potential development area, the amount of residential and non-residential development must be established. For each area, the following assumption was made:

Table 31: Potential development area broad assumptions

Potential development area	Number of residential units	Commercial space – B2 (m^2)
Project Heartland	440	0
Goat Mill Road	160	60,000
Hoover factory/Dragonparc	800	40,000

In addition to the numbers of residential units and commercial space, we have assumed that each development (due to their size) may have some local facilities provided, such as small shops and GP surgeries. The amount of local facilities provided has been based on what we see in similar sized developments elsewhere.

Table 32: Potential development area broad assumptions

	Retail	GP surgery	Primary school	Offices
Project Heartland	0	0	0	0
Goat Mill Road	50	150	1000	100
Hoover factory/ Dragonparc	50	150	1000	100

13.1.1 Energy demand from residential developments

As none of the potential developments currently have a profile of building archetypes established, we used ratios typical of many housing developments to set the projected numbers of homes built as flats, terraces, semi-detached or detached. For each development, this was set at:

Table 33: Assumptions used for residential building type ratios

Archetype	% of the development
Flat	12.5%
Terrace	37.5%
Semi-detached	37.5%
Detached	12.5%

For each archetype, a Standard Assessment Procedure (SAP) calculation was applied, based on the average kWh/yr demand per m^2 floor space for space heating, domestic hot water and electrical demands. This generated a 'notional building' for each archetype.

Table 34: Total energy demand for each residential building type

Residential building type	Average m2	Annual SH requirement (kWh)	Annual DHW requirement (kWh)	Total heat demand (kWh/yr)	Total elec demand (kWh/yr)
Flat	64	8,321	2,144	**10,468**	**3,100**
Terrace	87	11,147	2,416	**13,563**	**3,100**
Semi-detached	90	11,377	2,416	**13,793**	**3,100**
Detached	120	23,841	2,960	**26,801**	**3,100**

The kWh demand for each building archetype can simply be multiplied by the build-out rate to establish an annual demand for each development.

13.1.2 Energy demand from non-residential developments

Similar to the methodology for residential units, the estimated energy demand for commercial space comes from multiplying standard industry energy benchmarks[29] with the useable m^2 of commercial development.

This method provides an illustration of the potential energy demand generated by the development area. We have not used a non-residential SAP calculation, as this would apply very detailed calculations based on a single m^2 figure and would be no more accurate than using typical energy benchmarks.

Assumptions on the potential development areas has suggested that the non-residential developments will be limited to land use 'B', for which we can use an average energy demand as a proxy:

Table 35: Average energy demand for B land uses

Name	Electricity typical benchmark kWh/m2	Fossil thermal typical benchmark kWh/m2
General Office	95	120
Workshop	35	180
Storage facility	35	160
Average 'B' land use	55	153

Using the average energy demand per m^2 figure, we can calculate a rough figure for total non-residential energy demand for each potential development area. Of course, not all the space earmarked for non-residential development is actually built upon, as most of the space is used for highways, parking and green spaces. A factor is therefore applied to the commercial space identified in the development plan to account for this. This factor is known as the 'Built-on' factor and is generally set at 0.3 as an industry standard.[30]

Added to this, are the specific energy demands generated by the local facilities, again using industry benchmarks and typical sizes to establish estimated demands:

Table 36: Estimated energy demands for non-residential building types

Name	Energy benchmark category	Average m2	Fossil thermal typical benchmark kWh/m2	Electrical typical benchmark kWh/m2
Retail	3	50	66	165

Combining these figures gives an annual estimated demand for each potential development area for both heat and electricity.

[29] CIBSE Energy benchmarks, TM46:2008 & BSRIA Rules of Thumb, 5th Edition
[30] Given by Savills as 0.3, and seen in Local Development Plans from research work in the West Midlands

13.1.3 Build out rates

Merthyr Tydfil County Borough Council provided an indicative build out rate of 40 units a year for the residential units on each potential development area, starting in 2019. There was no indication of build out rate for non-residential development, so this was split evenly over the first four years of the development, 2019 -2022.

13.2 Results

13.2.1 Summary of a theoretical scenario energy demands

Project Heartland

Table 37: Project Heartland energy demands

Build out 2019-2029	Flat	Terrace	Semi	Detached	Commercial space* m2	Built-on commercial m2	Local facilities m2	Total Heat demand / kWh/yr	Total Elec demand / kWh/yr
2019-2029	55	165	165	55	0	0	0	**6,563,370**	**1,364,000**
Total builds		440							

*Non-residential space as specified in the Local Development Plan

Goat Mill Road

Table 38: Goat Mill Road energy demands

Build out 2019-2029	Flat	Terrace	Semi	Detached	Commercial space m2*	Built-on commercial m2	Local facilities m2	Total Heat demand kWh	Total Elec demand kWh
2019	**20**	**60**	**60**	**5**	**18,000**	**5400**	**1300**	**7,586,670**	**1,066,000**
Total builds		160							

*Non-residential space as specified in the Local Development Plan

Hoover factory / Dragonparc

Table 39: Hoover/Dragonparc energy demands

Build out 2019-2029	Flat	Terrace	Semi	Detached	Commercial space m2*	Built-on commercial m2	Local facilities m2	Total Heat demand kWh	Total Elec demand kWh
2019-2038	100	300	300	100	40,000	12,000	1300	**13,968,700**	**3,413,000**
Total builds		800							

*Non-residential space as specified in the Local Development Plan

13.2.2 Peak demands

In addition to calculating the annual energy demands for each potential development area, the likely peak demand must be estimated. Rather than using the SAP to establish the potential peak demands for each area, industry standards that are routinely used (as mentioned in section 13.1.2) in the buildings services sector have been used. These provide a clear indication of the peak demand that must be accommodated for each potential development area, useful for example when sizing district heat networks.

Not all the peak demands will occur at the same time. In particular, domestic hot water peak demands are quite widely spread throughout the day. This means that for a potential development area, the total peak demand is not simply the sum of all the peak demands. For some energy demands, a diversity factor must be applied to account for the offset of peak demands. Note, this does not apply to space heating, as if one building has its heating on, it is likely most/all of them will.

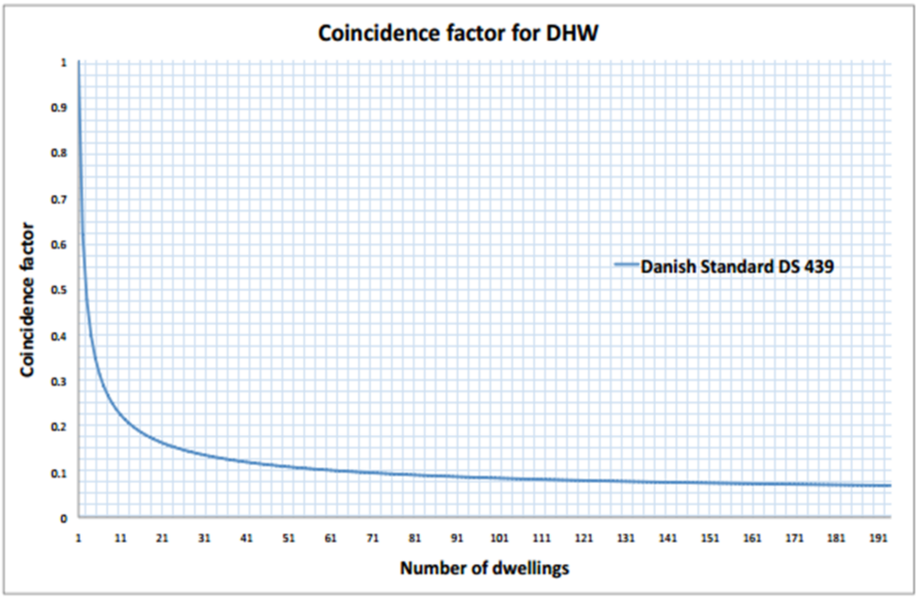

Figure 45: Danish Standard DS 439 diversity factors for district heat networks

For the purposes of using the peak heat demand for sizing district heating networks, the most appropriate source of diversity factors to use is the Danish Standard DS 439.

Table 40: Diversity factors for sizing DHNs

Heat demand		Diversity factor
Peak domestic hot water (residential)	28kW per unit	0.086
Peak space heat (residential)	5.5kW per unit	0
Peak heat (non-residential)	0.07 kW/m^2	0.8

As combined heat and power (CHP) plants are considered in the techno-economic analysis undertaken in section 15, it is also necessary to estimate the peak electricity demands of each area considered in this study. This can be undertaken through the use of more industry benchmarks.

For residential units, Western Power Distribution (the distribution network operator in Merthyr Tydfil) recommend using a peak figure of 2kW per unit, which already takes into account any diversity for developments over 100 units. All three of the potential development area being considered by this study are greater than 100 housing units.

For non-residential units, we have based the peak electrical demand on the kW/m^2 figure published by the Building Services Research and Information Association (BSRIA).

Table 41: Non-residential electricity demand (BSRIA)

Electricity demand	
Residential after diversity maximum demand (ADMD)	2kW per unit
Non-residential peak electricity demand	0.087 kW/m^2

13.2.3 Potential development area total energy demands

Table 42: Electricity and heat demands for the three potential development areas scenario tested

	Project Heartland	Goat Mill	Hoover/Dragonparc
Residential units (number)	440	440	800
Start date	2019	2018	2019
Units per year	40	40	40
Potential development size	0	60,000	40,000
Employment space ratio	0.3	0.3	0.3
Commercial space (m^2)	0	18,000	12,000
Heat demand - residential			
Peak DHW demand per property (kW)	28	28	28
Peak SH demand (kW)	5.5	5.5	5.5
Diversity for DHW	0.086	0.086	0.086
Total residential heat demand (MW peak)	**3.480**	**3.480**	**6.326**
Total residential annual demand (MWh)	**6,563**	**6,563**	**11,933**
Heat demand - commercial			
Peak heat demand (kW/m2)	**0.070**	**0.070**	**0.070**
Diversity factor	0.8	0.8	0.8
Total commercial heat demand (MW peak)	0	1.008	0.672
Total commercial annual heat demand (MWh)	0	1023.3	2035
Total heat demand per year (MWh)	**6,563**	**7,587**	**13,969**
Peak demand (MW)	**3.480**	**4.488**	**6.998**
Elec demand - residential			
After Diversity Maximum Demand (kW per unit)	2	2	2

ADMD (MW)	0.88	0.32	1.6
Total residential electricity demand	1,364,000	1,364,000	2,480,000
Elec demand - commercial			
Peak electricity demand (kW/m2)	0.087	0.087	0.087
Total peak electricity demand (MW)	0	1.566	1.044
Total electrical peak demand (MW)	**0.880**	**2.446**	**2.644**

14. E4 Task 3: Identify areas for strategic stand-alone renewable energy development

14.1 Method

Sites for wind, solar and biomass CHP have been identified where possible. Through the area wide resource assessment undertaken in E1 we have identified the least technically constrained areas for wind and solar PV. These results have been combined to produce Figure 46.

14.2 Results

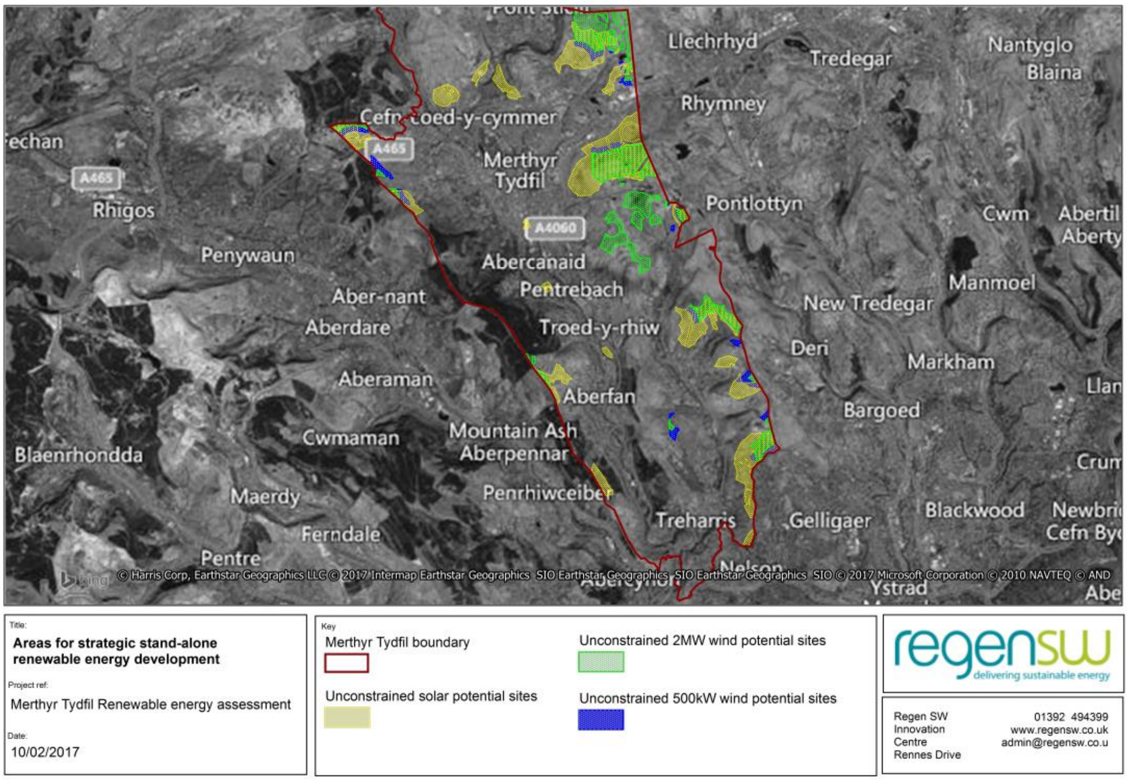

Figure 46: Areas for strategic stand-alone renewable energy development

The areas highlighted in figure 46 can be reviewed alongside other local considerations such as sites and feedback from planners and stakeholders and the plan assessment processes. Results of specific sites detailing those with the potential for private wires and co-location opportunities are discussed in section 17 - P2 Inform site allocations and 18 - P3 Identify opportunities and set targets for renewable energy on potential development areas.

14.3 Biomass CHP

The primary opportunity for any CHP plant is where the secondary heat can be sold locally. In theory, a biomass CHP plant can be placed anywhere that has good grid connections or a private wire route to a nearby demand, but in practice it is the ability to find a buyer for the heat that creates an economically viable scheme. For this reason, we have looked at biomass CHP plants as part of our assessment of DHNs, as this analysis will review the majority of significant heat demands in the area. Given the capacity of the grid and the locations of the existing high heat demands, we would not expect any additional opportunities for standalone CHP.

15. E4 Task 4: Assessing the technical feasibility and financial viability of DHNs

15.1 Method

Each of the five short-listed areas identified in section 12.9 were subjected to a techno-economic analysis. The analysis process was common to each area, examining whether biomass CHP, biomass heat only or gas fired heat networks might be viable. We have assumed that all the areas that were brought forward for techno-economic analysis were able to connect easily to the gas grid, as all relevant social housing sites were already connected[31].

It should be noted that we have purposefully modelled the current low cost of gas: this gives a conservative view of the potential investment in a heat network, and accounts for the potential rise of biomass woodchip costs relative to gas that we expect to see in the coming years.

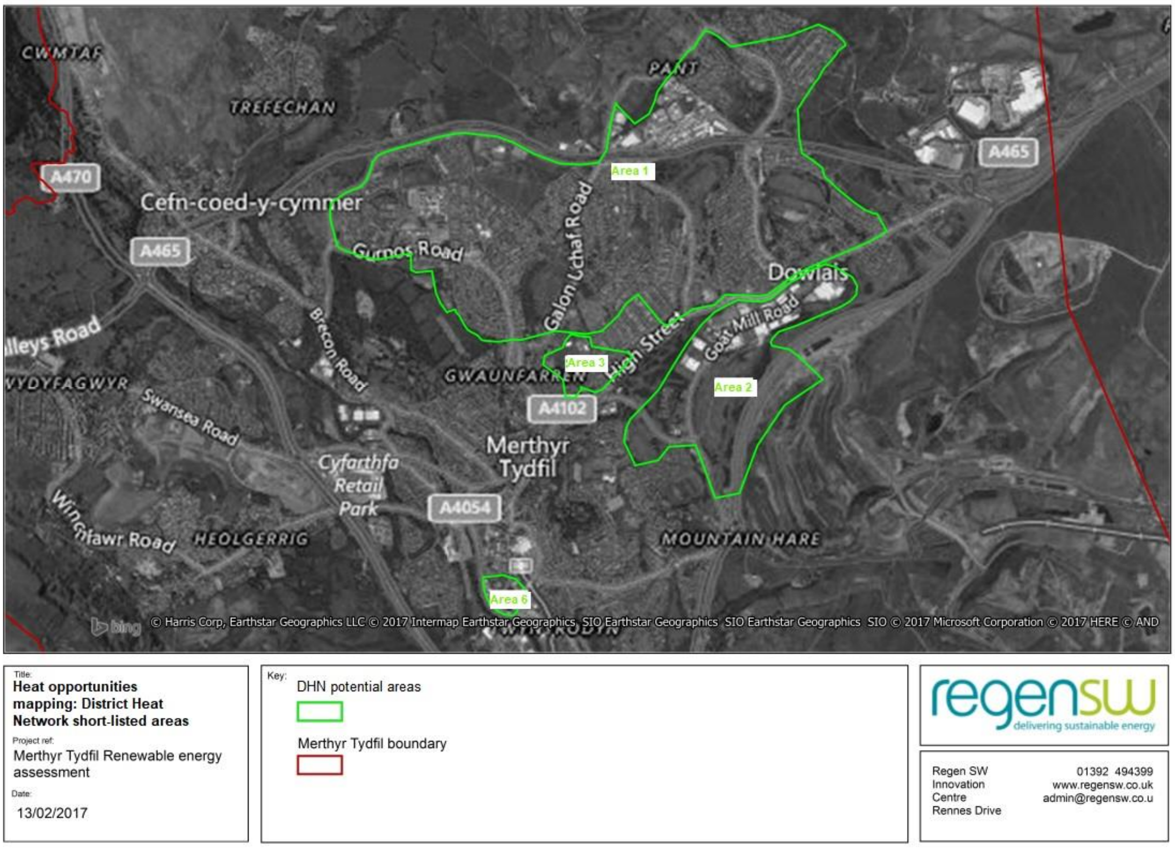

Figure 47: Location of the short listed areas (North sheet)

[31] http://www.wwutilities.co.uk/services/pipe-locations/

Figure 48: Location of the shortlisted areas (South sheet)

This analysis was undertaken using a number of industry standard benchmarks and assumptions, and should only be used as an illustration of the relative merits of each area. **None of the owners of the areas identified in the analysis as being potentially valuable as a heat network anchor load or location for energy centre have been approached.** Where possible, we have sought to evidence the energy demands of key buildings in the analysis, using publicly available data such as Display Energy Certificates[32]. Where it was not possible to evidence the energy demand of a building, we have relied on industry benchmarks to make an estimate.

15.2 Results

A number of scenarios were analysed, with Area 1 (being by far the largest) having five scenarios tested and Area 2 (Goat Mill development) have two scenarios tested.

Table 43: Areas examined for DHN opportunity under a range of scenarios

Techno-economic analysis	Anchor loads	Approx No. residential units
A	Area 1: Prince Charles Hospital + Pen-Y-Dre Secondary school	0
B	Area 1: Prince Charles Hospital + Pen-Y-Dre Secondary school	150
C	Area 1: Prince Charles Hospital + Pen-Y-Dre Secondary school	300

[32] https://www.cse.org.uk/projects/view/1259

D	Area 1: Project Heartland demands only	440
E	Area 1: Prince Charles Hospital + Pen-Y-Dre Secondary school + Project Heartland	1,500
F	Area 7: Hoover / Dragonparc: Industrial estate and commercial development	800
G	Area 2: Goat Mill Road development	440
H	Area 2: Goat Mill Road: OP Chocolate factory, S&G print, Cords Duaflex	500
I	Area 3: Bishop Hedley	120
J	Area 6: Caedraw Road	160

15.2.1 Gas fired networks

For each scenario in area 1, a gas fired heat network was modelled. In all scenarios, a gas driven heat network proved uneconomic, with costs higher than heat sales. As is common in heat networks, we modelled the unit price paid by residential customers to be 10 per cent less than the gas price.

This feature of the model effectively means that for all of the retrofit opportunities, gas fired networks will prove uneconomic and so were excluded from further analysis.

For the potential new-build areas, it was assumed that gas fired networks would automatically be viable if biomass heat only networks proved viable. This is because all the areas short-listed had access to gas mains close by and the installation of heat interface units in new build developments can be offset against the cost of individual gas connections and boilers, and laying heat network pipework can be offset against trenching for gas mains. However, the carbon savings associated with a gas driven network compared to individual connections are far lower than if a biomass fed network was installed.

15.2.2 Heat pumps

Water source and ground source heat pumps are increasingly being considered as heat sources to partially supply heat networks.[33]

However, a number of recent studies conclude that although heat pumps can lower the carbon footprint of a district heat network scheme, they significantly increase the project cost, by at least 35 per cent.[34]

For this reason, we have not included heat pump technologies in our techno-economic analyses. However, two of the areas that have been shortlisted (Area 7 Hoover/Dragonparc and Area 6 Caedraw Road) are situated adjacent to the river Taff. As water source heat pump networks are still considered innovative, there may be scope to attract development funding to explore this technology at these areas, but we are not considering heat pumps as a commercially viable option.

[33] http://www.esru.strath.ac.uk/Documents/MSc_2015/Lyden.pdf
[34] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/502500/DECC_Heat_Pumps_in_District_Heating_-_Final_report.pdf

15.2.3 System sizing

For the purposes of this study, and in line with industry practice, the CHP plants have been sized to accommodate close to 100 per cent of the electricity demand of the area, normally through two units meeting baseload and peak demands respectively. This then generates a surplus amount of heat which is available to use in the heat network. Both the CHP and heat only solutions supply up to about 80 per cent of the areas heat demand. The rest is made up from a gas backup unit. The costs for installing and running this gas backup unit have not been modelled in this study, as they are common to all the solutions we analysed.

15.3 Techno-economic analysis

15.3.1 Area 1 – Prince Charles Hospital and project Heartland

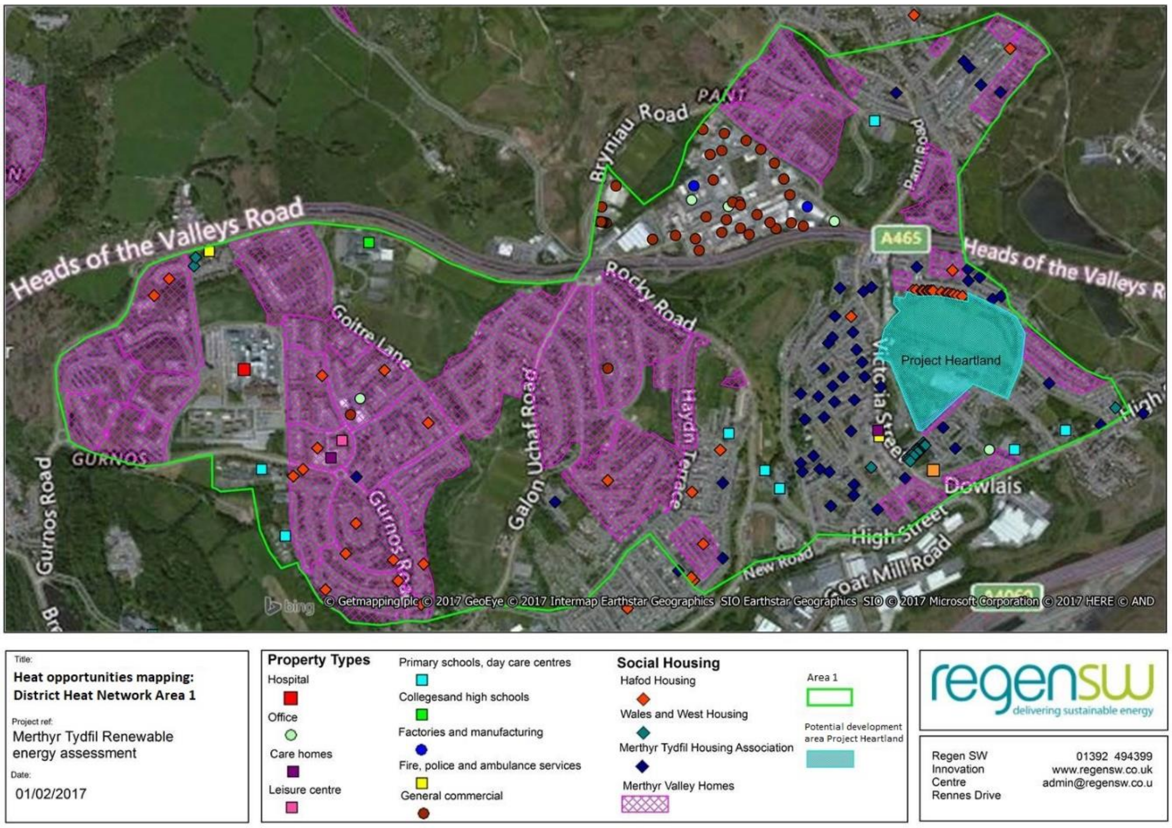

Figure 49: Broad view including potential development area, industrial estate and social housing

The top scoring area on the shortlist was a large cluster that features up to 1500 homes, an acute treatment hospital, several schools and a vacant area of previously developed land (Project Heartland). The area is large, due to the substantial amount of social housing in close proximity and good mix of potential anchor loads.

However, as shown in Figure 50 there is a major road, the A465, running through the area from East to West, which would add major cost to any network attempting to cross it. However, work is programmed in the near future on the A465 in this location.

The social housing sites north of the A465 are relatively small, and the nearby industrial estate does not appear to host any significant loads. For these reasons, the demand north of the A465 was excluded from the modelling of this area, but could potentially play a role if a network was installed.

There is also a CHP project planned at the Pen-Y-Dre school. We have not been able to verify the status of this project, and so it has been excluded from our modelling of this area.

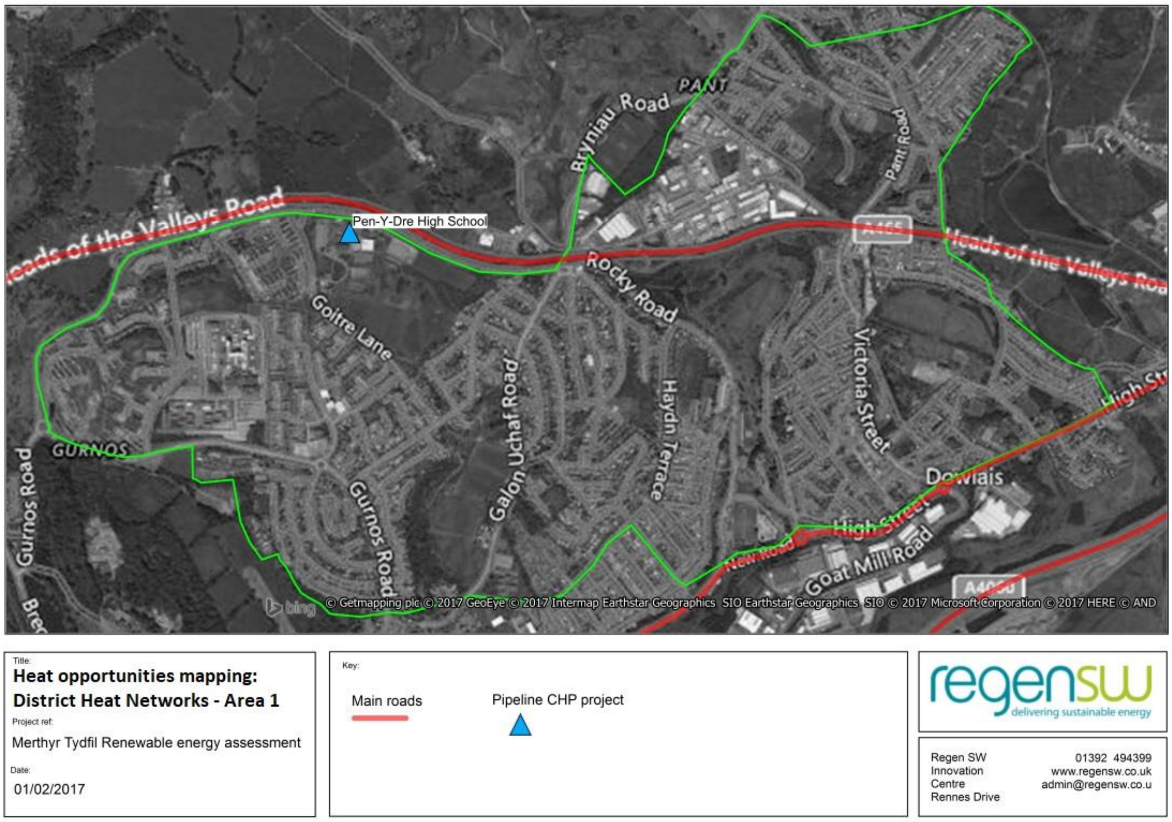

Figure 50: Broad view of the cluster including potential development area, and key infrastructure

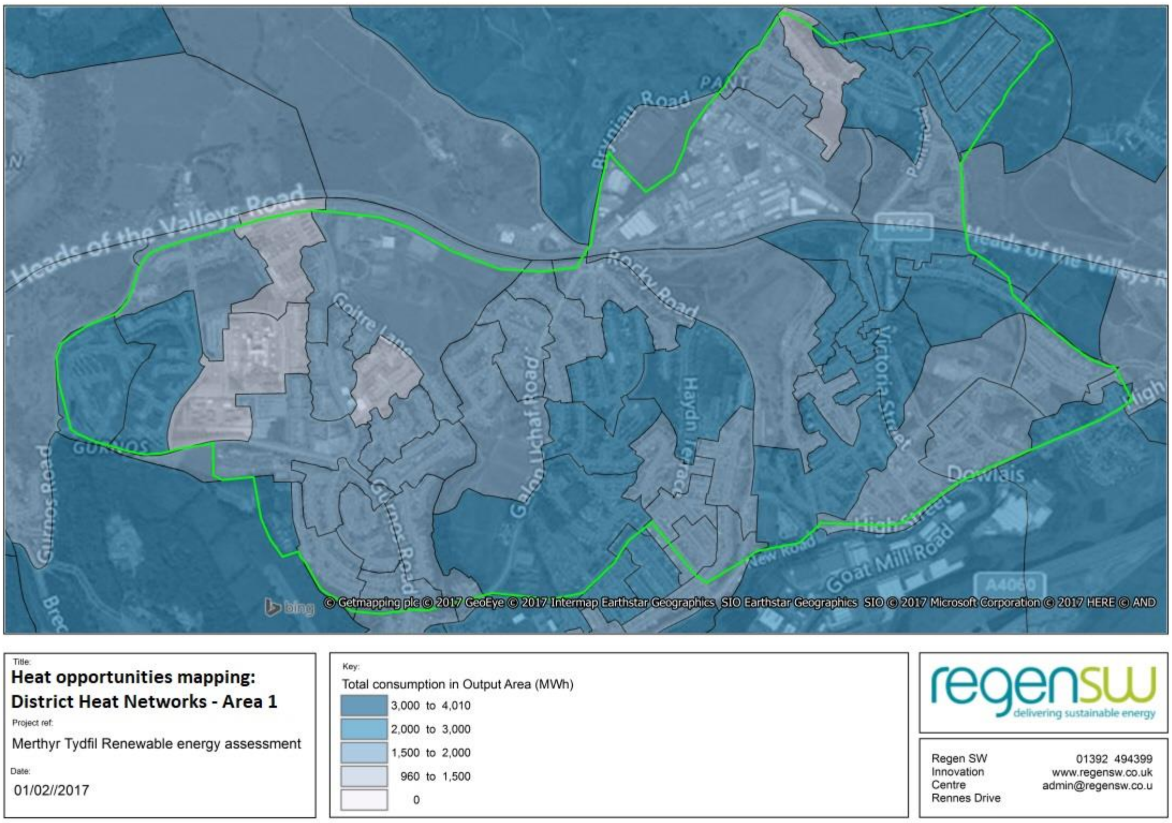

Figure 51: Broad view of heat consumption for the area

The Prince Charles hospital offers a very good anchor load for any heat network, with an annual heat demand of nearly 18 GWh, and an electrical demand of 3 GWh, all in very close proximity to a significant social housing site. In addition, there is a secondary school nearby with additional significant energy demands (1.9 GWh of heat and 0.5 GWh electricity). It has not been confirmed that Prince Charles hospital does not already have a CHP plant.

We analysed this area in five separate scenarios, to investigate what proportion of the overall area may be suitable to support a district heat network. These scenarios were:

Table 44: Scenarios for area 1 DHN analysis

Scenario	Anchor loads	No. residential units	Residential unit type
A	Prince Charles Hospital + Pen-Y-Dre Secondary school	0	-
B	Prince Charles Hospital + Pen-Y-Dre Secondary school	150	Existing
C	Prince Charles Hospital + Pen-Y-Dre Secondary school	300	Existing retrofit
D	Project Heartland demands only	440	
E	Prince Charles Hospital + Pen-Y-Dre Secondary school + Project Heartland	1500	

Retrofitted heat network sites are often viable at large scales, supplying large clusters of housing, but are deemed too risky to invest in at that scale. As such, most retrofit heat networks start as small connected clusters of anchor loads and close proximity social housing. Once built, additional connections can be phased in. For that reason, we examined area 1 with a range of anchor loads and housing connections to establish how scale affects the economic viability.

Table 45: Area 1 modelling results 1

Area 1 TE analysis	No. residential units	Km of pipework	Viability of strategic DHN (NPV over study period) CHP	Heat only	Viability of strategic DHN (simple payback, yrs) CHP	Heat only
A	0	0.5	£ 661,000	£ 4,207,000	4	4.1
B	150	2.3	-£ 1,140,000	£ 3,281,000	8	6.8
C	300	3.9	£ 1,731,000	£ 3,945,000	8	6.9
D	440	2.2	-£ 683,000	£ 1,321,000	13	18.1
E	1500	6	-£ 2,586,000	£ 8,039,000	7	6.6

	Scenario A		Scenario B		Scenario C	
	Anchor loads	Prince Charles Hospital	**Anchor loads**	Prince Charles Hospital	**Anchor loads**	Prince Charles Hospital
		Pen-Y-Dre High School		Pen-Y-Dre High School		Pen-Y-Dre High School
	Residential loads (units)	0	**Residential loads (units)**	150	**Residential loads (units)**	300
	Biomass CHP	Biomass Heat only	Biomass CHP	Biomass Heat only	Biomass CHP	Biomass Heat only
Study lifetime (hrs operation)	60,000	83,000	60,000	83,000	60,000	83,000
Capacity kW / kWth	470+150	2,200	500+250	2,500	550+250	3,000
Length of pipework (km)	0.5	0.5	3	3	3.9	3.9
CO2e savings (TCO2e)	2,654	2,611	2,908	2,968	3,175	3,561
% electricity demand met	99%	-	98%	-	97%	-
Annual heat generation (MWh)	5,100	15,500	5,600	17,700	6,100	3,600
% heat demand met	24%	80%	26%	82%	26%	91%
Initial investment	£2m	£2.2m	£4.1m	£4.4m	£5.1m	£5.6m
Annual O&M cost	£43,400	£16,600	£47,500	£18,800	£51,900	£22,600

Annual fuel costs	£337,000	£598,000	£369,000	£679,000	£403,000	£815,000
Annual energy savings	£510,000	£420,000	£575,000	£492,000	£643,000	£604,000
Annual RHI	£216,000	£319,000	£236,000	£363,000	£258,000	£435,000
Annual energy sales	£138,000	£420,000	£156,000	£491,000	£174,000	£604,000
Discount rate	10%	10%	10%	10%	10%	10%
Simple payback / yrs	4	4.1	8	6.8	8	6.9
Simple ROI	25%	24%	13%	15%	12%	14%
NPV over study period	£661,000	£4,207,000	-£1,140,000	£3,281,000	£1,731,000	£3,945,000

Table 46: Area 1 modelling results 2

	Scenario D		Scenario E	
	Anchor loads	Secondary school scale	**Anchor loads**	2* Secondary school scale
				Prince Charles Hospital
	Residential loads (units)	440	**Residential loads (units)**	1500
	Option 1	Option 2	Option 1	Option 2
	Biomass CHP	Biomass Heat only	Biomass CHP	Biomass Heat only
Study lifetime (hrs operation)	60,000	83,000	60,000	83,000
Capacity kW / kWth	550+150	2,500	1,000+550	5,000
Length of pipework (km)	2.2	2.2	6	6
CO_2e savings (TCO_2e)	1,201	1,070	5,863	5,935
% electricity demand met	100%	-	98%	-
Annual heat generation (MWh)	2,300	6,400	11,300	35,400
% heat demand met	31%	85%	27%	88%
Initial investment	£3,645,000	£3,784,000	£9,588,000	£10,117,000
Annual O&M cost	£19,600	£18,800	£95,800	£37,600
Annual fuel costs	£152,500	£244,800	£744,400	£1,458,000
Annual energy savings	£288,000	£170,700	£1,302,000	£1,104,000
Annual RHI	£98,000	£131,000	£476,300	£725,000
Annual energy sales	£62,000	£171,000	£353,000	£1,104,000
Discount rate	10%	10%	10%	10%
Simple payback / yrs	13	18.1	7	6.6

Simple ROI	4%	6%	13%	15%
NPV over study period	-£683,000	£1,321,000	-£2,586,000	£8,039,000

As can be seen in the output table above, the most economically viable solutions are biomass fuelled:
Viable solutions including CHP:

- heat only for the school and CHP for the hospital
- heat only for the school and 300 homes and CHP options for the hospital

Viable 'Heat only' solutions (no CHP)

- All scenarios.

Modelling summary

In the model outputs for each of the five scenarios, a heat only network is shown to be potentially viable, with the best performing scenario being the largest network of all: 1,500 homes (including 440 new build properties on the Project Heartland development), the hospital and the nearby secondary school. As a first phase however, a network simply connecting the school to the hospital could be commercially viable.

Interestingly, the electrical demand profile of the scenarios mostly prove difficult for a CHP plant, apart from scenario A (just the hospital and school) and B, the hospital, school and 300 homes.

15.3.2 Area 7 - Hoover / Dragonparc

The Hoover / Dragonparc potential development area and potentially some additional demands from the nearby industrial estate and clusters of social housing. However, the area is split in two by the river Taff and a main road, which will add cost and complexity to any network developed here.

Using Google Earth, we were able to establish that the largest occupiers of the industrial estate, (which we assumed to also be the highest demands) were the Kasai and Amnitec factories. We also included the Merthyr Tydfil Institute for the Blind as a non-domestic anchor load, although the impact of this was small.

We were unable to establish through desktop research what the energy demands for the anchor loads are, but included estimates for heat and electricity demand based on industry benchmarks for factories of this type.

The bulk of the demands attached to this area arise from the modelled demand from the potential development area, rather than existing demand. (See table 42).

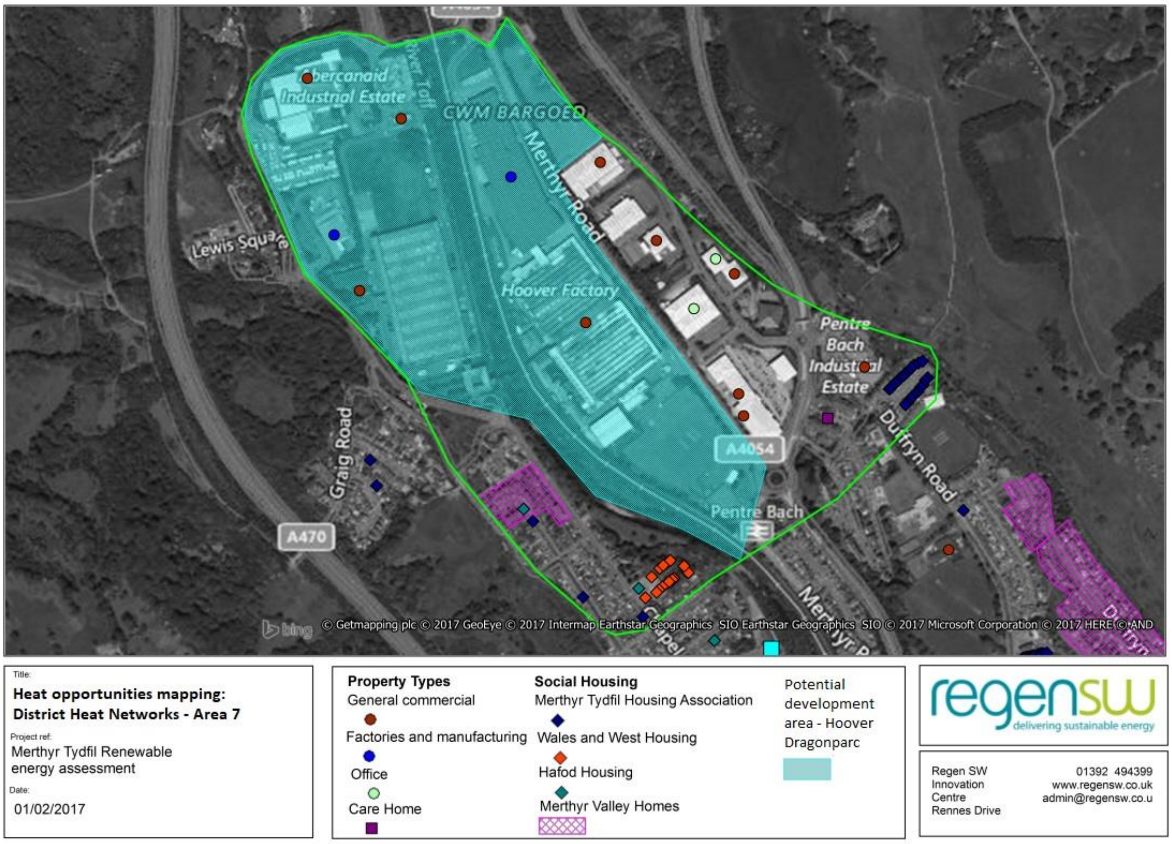

Figure 52: Broad view of the area including nearby social housing

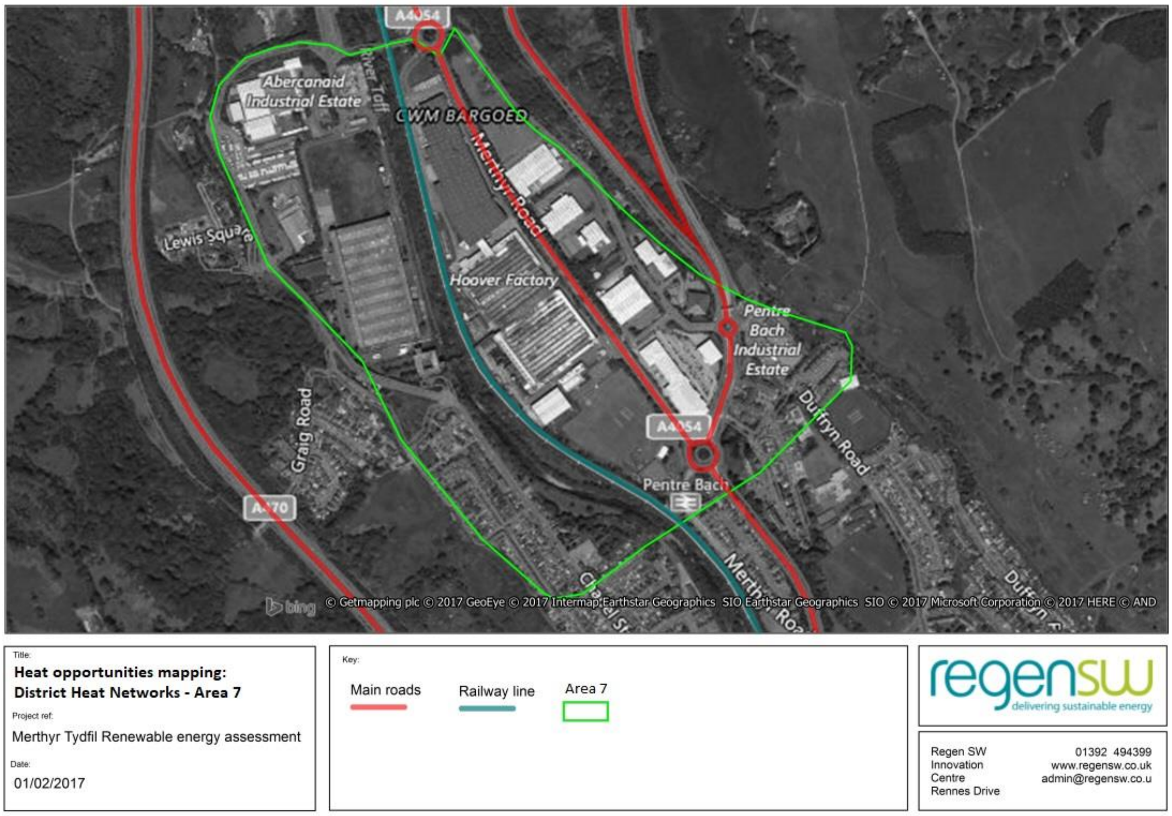

Figure 53: Broad view of the area including key infrastructure

Table 47: Area 7 modelling results

Area 7 TE analysis	Anchor loads	No. residential units	Viability of strategic DHN (NPV over study period)		Viability of strategic DHN (Simple payback, yrs)	
			CHP	Heat only	CHP	Heat only
F	Area 7: Hoover / Dragonparc: Industrial estate and commercial development	820	-£ 8,051000	£ 2,806,000	34	42.7

Scenario F		
	Anchor loads	Kasai factory
		MT institute for the blind
		Amintec
	Residential loads (units)	820
	Option 1	**Option 2**
	Biomass CHP	Biomass Heat only
Study lifetime (hrs operation)	60,000	83,000
Capacity kW / kWth	4,200+100	5,000
Length of pipework (km)	3	3
CO2e savings (TCO_2e)	1,842	937
% electricity demand met	98%	-
Annual heat generation (MWh)	3,550	5,590
% heat demand met	56%	88%
Initial investment	£12,720,000	£10,410,000
Annual O&M cost	£30,100	£37,500
Annual fuel costs	£234,000	£ 214,000
Annual energy savings	£367,000	£191,000
Annual RHI	£1,450,000	£114,000
Annual energy sales	£121,000	£191,000
Discount rate	10%	10%
Simple payback / yrs	35	44.5
Simple ROI	3%	2%
NPV over study period	-£8,051,000	£2,800,000

The modelling indicates that this area does not offer particularly good grounds for supporting a heat network, primarily down to the lack of anchor loads in the vicinity, remembering of course that these anchor loads are desktop estimates. Should the anchor loads for the factories be significantly higher, or new high demand move into the development area, then this scenario may well prove viable.

Both CHP and heat only plants are modelled to have long payback times, of 35 and 44.5 years respectively.

As the vast majority of the housing making up this area is new build (some 800 of the 820 homes), some of the costs associated with installing the Heat Interface Units (HIUs) can be offset against the standard gas connections per unit. This was taken into account by halving the install cost of an HIU.

15.3.3 Area 2 - Goat mill development

The Goat mill potential development area is a very similar opportunity to that of Area 7 Hoover/Dragonparc, namely a mixed-use area located next to an existing industrial estate. The potential development area comprises 440 new build homes and approximately 40,000m^2 of commercial space. This location also benefits from several existing potential anchor loads: the OP Chocolate factory, a print works and manufacturing plant.

Loads for the chocolate factory have been estimated from recent work published, outlining efforts they have made in reducing energy demand.[35]

Given the small footprint of area 2, and the size of the anchor loads available, this looks to be a good opportunity for a potential heat network, despite being split by the A4060.

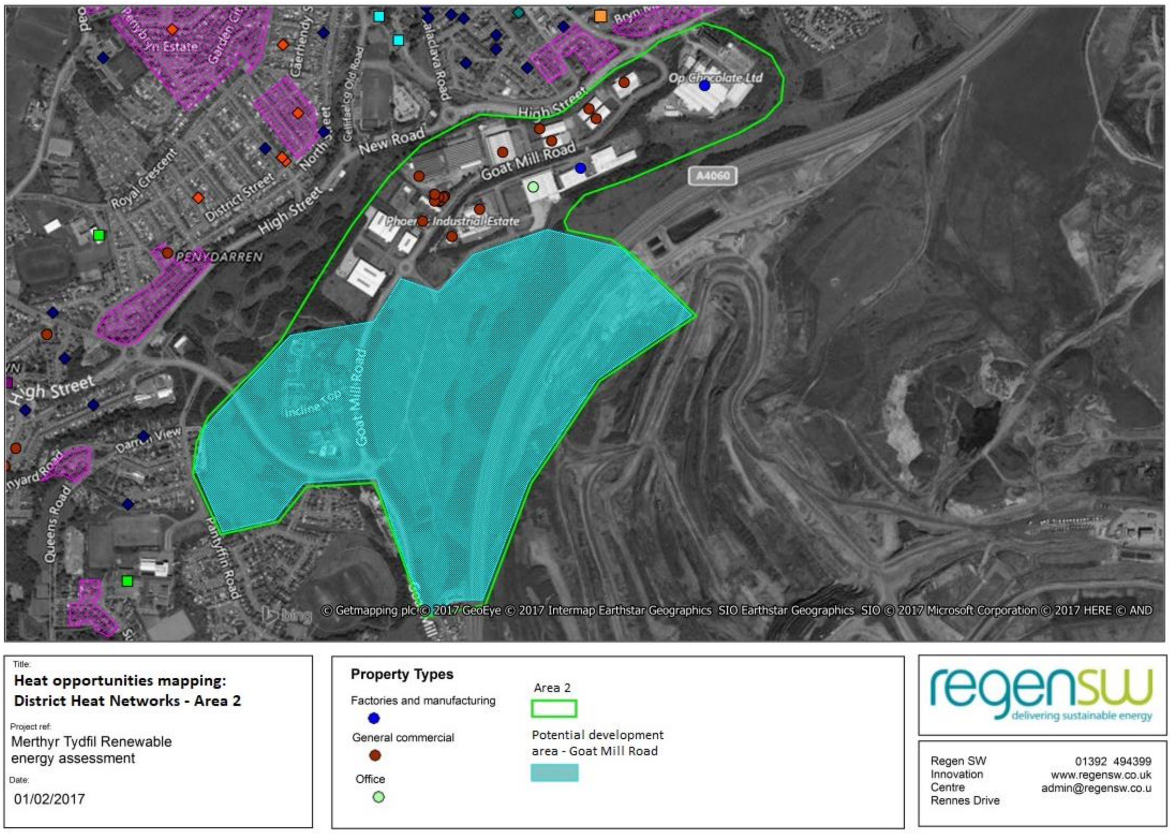

Figure 54: Broad view of the area including nearby social housing

[35] http://innovativeenergy.co.uk/iec_case_study/op-chocolate/

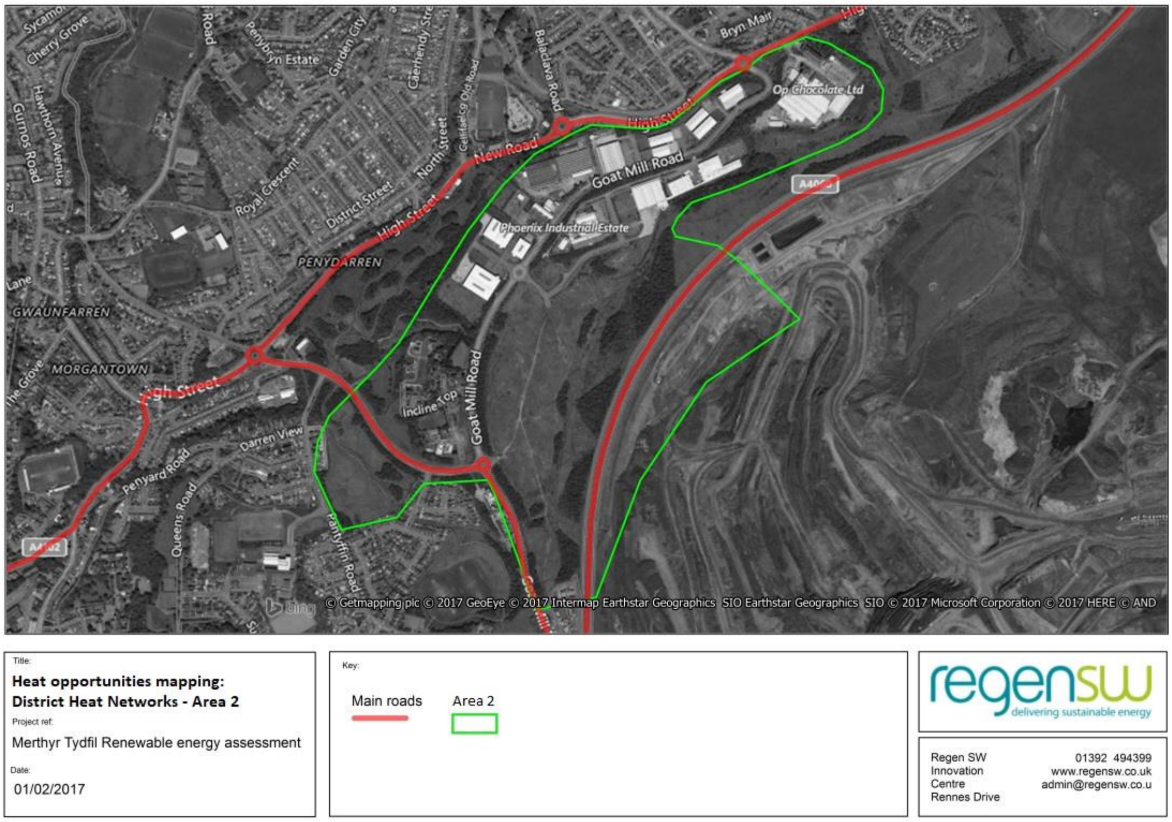

Figure 55: Broad view of the area including key infrastructure

Table 48: Area 2 modelling results

Area 2 TE analysis	Anchor loads	No. residential units	Viability of strategic DHN (NPV over study period)		Viability of strategic DHN (Simple payback, yrs)	
			CHP	Heat only	CHP	Heat only
G	OP Chocolate factory S&G Print Cords Duaflex	440	-£ 1,827,000	-£ 1,056,000	17	13.8
H	OP Chocolate factory S&G Print Cords Duaflex	500	-£1,682,000	-£1,028,000	21	14.9

	Scenario G		Scenario H	
	Anchor loads	**OP Chocolate**	**Anchor loads**	**OP Chocolate**
		Cords duaflex		**Cords duaflex**
		S&G print		**S&G print**
	Residential loads (units)	**440**	**Residential loads (units)**	**500**
	Option 1	Option 2	Option 1	Option 2
	Biomass CHP	Biomass Heat only	Biomass CHP	Biomass Heat only
Study lifetime (hrs operation)	60,000	83,000	60,000	83,000
Capacity kW / kWth	1,100+100	12,000	1,100+150	12,000
Length of pipework (km)	2.5	2.5	2.5	2.5
CO2e savings (TCO_2e)	2,214	2,249	2,261	2,249
% electricity demand met	99%	-	96%	-
Annual heat generation (MWh)	4,260	13,400	4,300	13,400
% heat demand met	27%	86%	25%	75%
Initial investment	£5,041,000	£7,340,000	£5,090,000	£7,340,000
Annual O&M cost	£36,100	£90,000	£37,000	£90,000
Annual fuel costs	£281,000	£515,000	£287,000	£514,400
Annual energy savings	£278,000	£445,000	£322,000	£515,000
Annual RHI	£180,000	£275,000	£184,000	£275,000
Annual energy sales	£132,000	£414,000	£135,000	£415,000
Discount rate	10%	10%	10%	10%
Simple payback / yrs	17	13.8	16	13.7
Simple ROI	6%	7%	6%	7%
NPV over study period	-£1,830,000	-£10,560,000	-£1,683,000	-£1,028,000

Despite the significant loads estimated for the chocolate factory and S&G print works, the modelling indicates that there is still insufficient kWh available to support a large heat network that could engage with 440 homes. This is likely to be because the chocolate factory operates two shifts a day. If it could be shown that one or more of the anchor loads has more heat demand than we estimated, this opportunity area could become viable.

Similar to area 7, the savings available to the developer for not connecting each property to the gas network has been accounted for by reducing the HIU installation cost by 50 per cent.

15.3.4 Area 3 - Bishop Hedley

The Bishop Hedley area offers two anchor loads (schools) in close proximity to the existing social housing cluster of up to 120 units. This area offers relatively high density demand and plenty of space to host the network pipes and energy centre.

Figure 56: Broad view of the area including nearby social housing

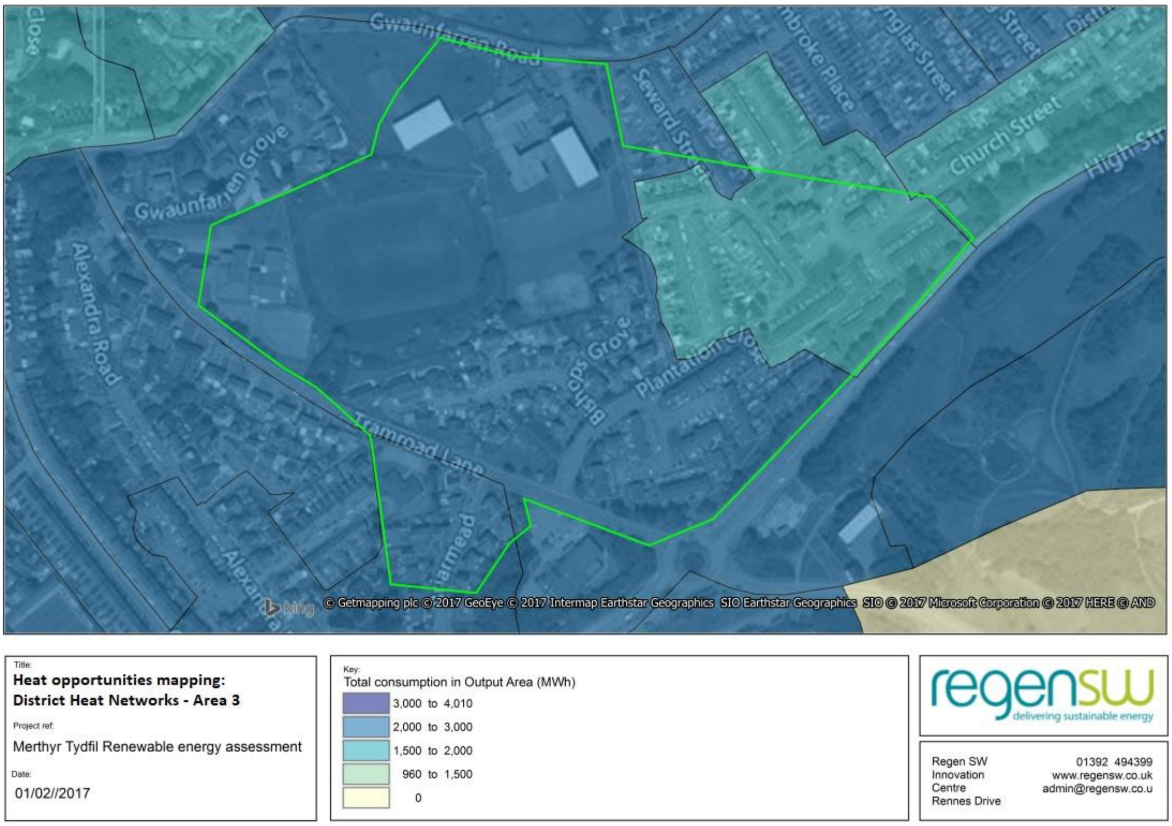

Figure 57: Total heat consumption per output area

Table 49: Area 3 modelling results

Area 3 TE analysis	Anchor loads	No. residential units	Viability of strategic DHN (NPV over study period)		Viability of strategic DHN (simple payback, yrs)	
			CHP	Heat only	CHP	Heat only
I	Area 3: Bishop Hedley	120	-£ 941,000	-£ 2,476,000	17	37.6

Scenario I		
	Anchor loads	**Bishop Hedley school**
		Gwaunfarren Primary School
	Residential loads (units)	**120**
	Option 1	Option 2
	Biomass CHP	Biomass Heat only
Study lifetime (hrs operation)	60,000	83,000
Capacity kW / kWth	350+40	5,000
Length of pipework (km)	2	2
CO2e savings (TCO₂e)	712	937
% electricity demand met	98%	-
Annual heat generation (MWh)	1,370	5,590
% heat demand met	20%	82%

Initial investment	£2,530,000	£3,600,000
Annual O&M cost	£11,600	£37,500
Annual fuel costs	£90,400	£214,000
Annual energy savings	£163,200	£117,000
Annual RHI	£57,900	£115,000
Annual energy sales	£28,600	£117,000
Discount rate	10%	10%
Simple payback / yrs	17	37.6
Simple ROI	6%	3%
NPV over study period	-£941,000	-£2,500,000

The modelling suggests very long paybacks for this scenario, with insufficient demand available from the schools to overcome the relatively high length of pipework needed, compared to the number of social housing units to be supplied.

15.3.5 Area 6 – Caedraw Road

The Caedraw Road area offers some of the best conditions in Merthyr Tydfil for a heat network project, apart from Area 1. This is because the social housing is in short-rise blocks of flats which, despite having lower heat losses than terraces or semi-detached homes, offer low pipework connection costs. In addition, there is a school next door, with further options to connect non-domestic demand close by.

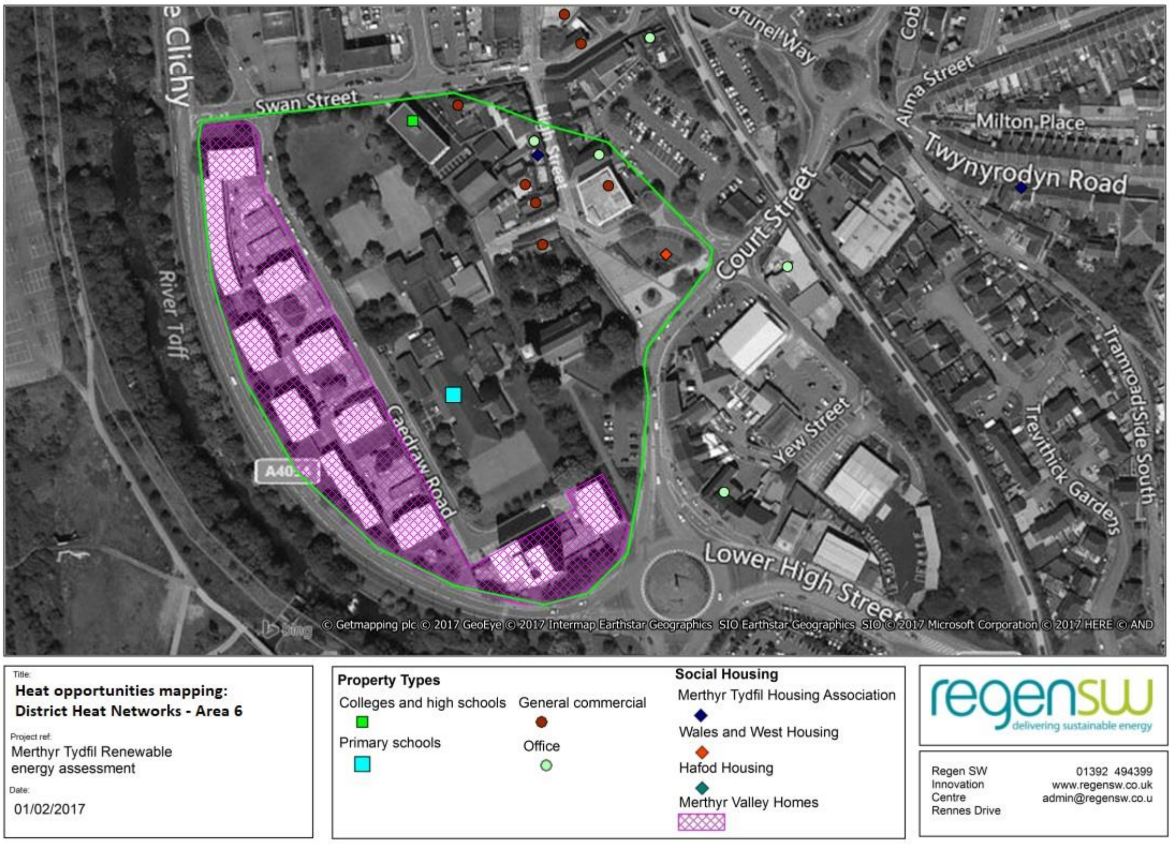

Figure 58: Broad view of the area including nearby social housing

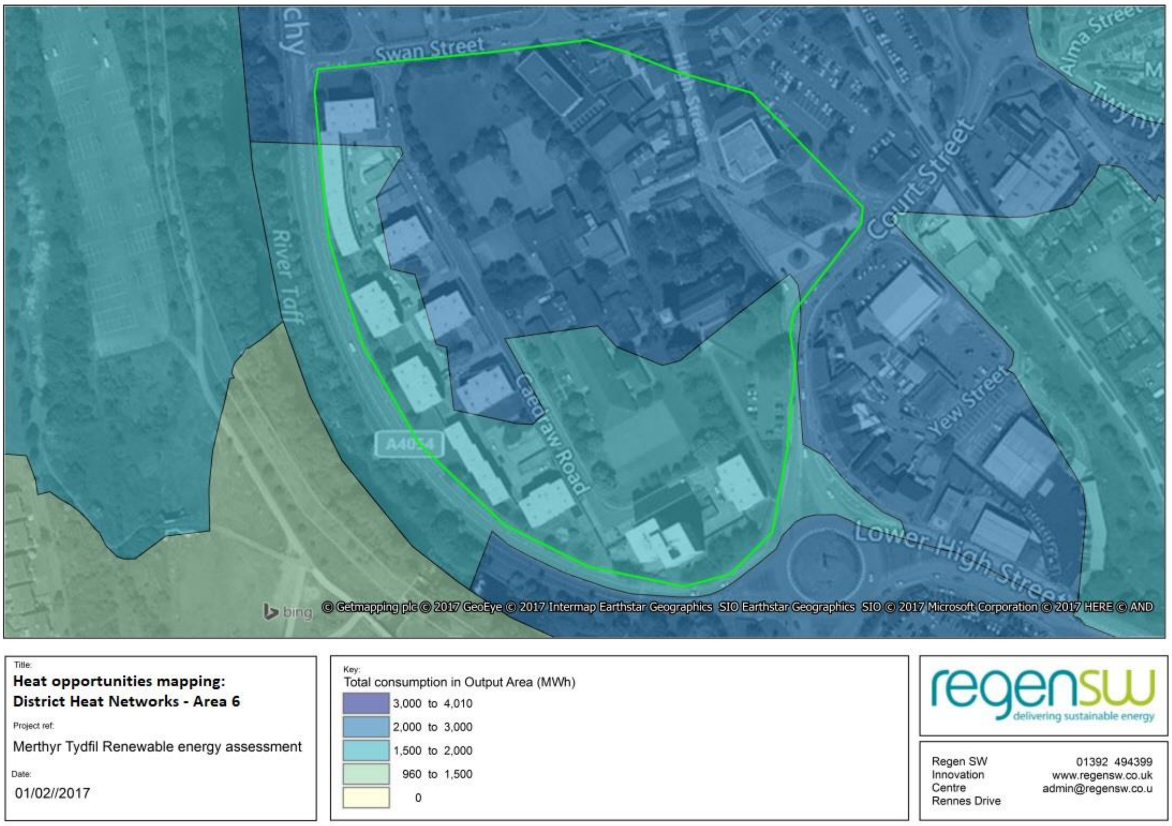

Figure 59: Total heat consumption per output area

Table 50: Area 6 modelling results

TE analysis	Anchor loads	No. residential units	Viability of strategic DHN (NPV over study period)		Viability of strategic DHN (simple payback, yrs)	
			CHP	Heat only	CHP	Heat only
J	Area 4: Caedraw Road	160	-£251,000	£3300	14	11.8

Scenario J		
	Anchor loads:	**Caedraw Primary**
		Education college
	Residential loads (units):	**160**
	Option 1	**Option 2**
	Biomass CHP	**Biomass Heat only**
Study lifetime (hrs operation)	60,000	83,000
Capacity kW / kWth	170+20	3,500
Length of pipework (km)	0.8	0.8
CO2e savings (TCO$_2$e)	346	656
% electricity demand met	97%	-
Annual heat generation (MWh)	670	3,900
% heat demand met	16%	95%

Initial investment	£1,241,000	£2,060,000
Annual O&M cost	£5,700	£26,300
Annual fuel costs	£44,000	£150,000
Annual energy savings	£88,000	£135,000
Annual RHI	£28,000	£80,000
Annual energy sales	£23,100	£135,000
	10%	10%
Discount rate	14	11.8
Simple payback / yrs	7%	8%
Simple ROI	-£251,000	£3,345
NPV over study period	60,000	83,000

The modelling indicates that for a small network, the scenario could offer a commercial heat only solution that pays back within 12 years. If additional commercial demands could be encouraged to connect, this payback period could be expected to improve.

Natural limitations to this area are the river Taff to the west and railway to the east. This may impair the long-term growth of the network to other areas of social housing or non-domestic demand. In addition, green space would have to be sacrificed to host a fuel store/energy center unless this can be accommodated on the school footprint.

15.3.6 Heat opportunity finding – conclusions

Table 51: Techno-economic analysis summary

TE analysis	Anchor loads	No. residential units	Viability of strategic DHN (NPV over study period)		Viability of strategic DHN (simple payback, yrs)	
			CHP	Heat only	CHP	Heat only
A	Area 1: Prince Charles Hospital + Pen-Y-Dre Secondary school	0	£ 661,000	£ 4,200,000	4	4.1
B	Area 1: Prince Charles Hospital + Pen-Y-Dre Secondary school	150	-£ 1,140,000	£ 3,280,000	8	6.8
C	Area 1: Prince Charles Hospital + Pen-Y-Dre Secondary school	300	£ 1,730,000	£ 3,900,000	8	6.9
D	Area 1: Project Heartland demands only	440	-£ 683,000	£ 1,321,000	13	18.1
E	Area 1: Prince Charles Hospital + Pen-Y-Dre Secondary school + Project Heartland	1500	-£ 2,586,000	£ 8,039,000	7	6.6

F	Area 7: Hoover / Dragonparc: Industrial estate and commercial development	800	-£ 8,482,000	£ 2,376,000	35	44.5
G	Area 2: Goat Mill Road development	440	-£ 314,000	-£ 1,703,000	12	19.9
H	Area 2: Goat Mill Road: OP Chocolate factory, S&G print, Cords Duaflex	500	-£ 2,989,000	-£ 1,725,000	21	14.9
I	Area 3: Bishop Hedley	120	-£ 941,000	-£ 2,476,000	17	37.6
J	Area 6: Caedraw Road	160	£ -251,000	£ 3300	14	11.8

The most likely scenarios for a viable heat network in Merthyr Tydfil are:

Table 52: Most viable areas for a district heat network

Scenario	CO_2 savings tCO_2/yr	Investment costs (indicative)	Payback (indicative)
A - Hospital and school only	2,654	£2.0m	4 years
B - Hospital and school and social housing	2,968	£4.4m	7 years
C - Hospital and school and social housing	3,561	£5.6m	7 years
J – Caedraw Road and school	656	£2.1m	12 years

There are several sites in Merthyr Tydfil that could appropriate for a heat network to be viable, as outlined in table 52, which are a mixture of existing demand and potential demand from development sites.

However, there are a number of issues that should be considered.
The high level of gas connectivity in Merthyr Tydfil makes retrofitted heat networks a difficult financial proposition, as most properties are already using one of the cheapest fuels to heat their homes and businesses. However, for the potential development areas there is opportunity to encourage heat network provision, being mindful that Goat Mill and Hoover/Dragonparc have rivers and roads running right through them, which currently make heat networks difficult and expensive to implement. The viability of these opportunity areas is also dependent on the profile of the non-domestic heat users. Ideally, constant demand provides the best operational profile, and a high number of kWh/yr makes best of the system, improving efficiency.

It should be noted that due to the high level of gas connection in the area, swapping heat loads to a heat network (even if it is biomass) does not save huge volumes of CO_2. Indeed, the savings can only be realised for a biomass system if the wood fuel is secured locally and not transported great distances. The Renewable Heat Incentive represents a significant income stream for biomass heat networks and CHP. It should be remembered that the RHI has budget confirmed until 2021, but each tariff is open to change with very little notice.

Running a heat network requires investment in the 'owner' organisation too, that is not reflected in the modelling we undertook. There are numerous routes to enabling the 'Energy Supply Company', either relying on the private sector to make the investment and manage billing customers, or for the local authority to take a role.

The hospital is by far the most suitable load to support a heat network and has the space for energy centre/fuel depots and connection to local social housing. But again, these loads are already gas connected, so enquiries should be made with the hospital about any plans they have for replacing existing heating equipment that could stimulate an interest in a heat network.

Note: the above observations are based on desktop research and estimates of energy demand and housing provision. They are intended to give an illustration of potential heat network schemes only.

15.4 Next steps

There are a small number of areas in Merthyr Tydfil that may be suitable for a retrofitted heat network. These are likely to have low commercial margins, but could benefit tenants of social housing with more consistent and potentially lower heating bills. Of these areas, the Prince Charles Hospital offers the most value, being a high energy demand site and is in close proximity to a large estate of social housing. We would recommend an early conversation with the Hospital and nearby secondary school to potentially form the basis of a retrofitted heat network scheme.

In general, schools offer a good anchor load for schemes. MTCBC should review the energy provision for the schools in the local authority area to examine if any would benefit from converting to biomass. Increasing the pool of biomass plants in the area may help improve the supply chain and help to lower costs, as well as boost local employment.

Funding is available from the HNDU (Heat Networks Delivery Unit, a part of the department for Business, Energy and Industrial Strategy), up to 67 per cent, to help local authorities build projects. The funding can be used for:

- Heat mapping
- Energy masterplanning
- Project feasibility
- Project development
- Commercialisation

MTCBC could explore the heat opportunities outlined in this study with the key anchor load owners identified in this study (in particular the hospital, schools and chocolate factory), and approach HNDU to discuss putting forward an application.

We also recommend that if MTCBC are interested in taking any heat network opportunities further, they join the 'Vanguards Network', a government supported network for local authorities to share learning in building heat network projects. More information can be found here:

http://www.heatandthecity.org.uk/dh_vanguards_network

16. P1 Develop area wide renewable energy targets

16.1 Why set a renewable energy target?

A stretching target is useful to show the area's ambition for renewable energy. By including an ambitious target in planning policy, it helps to send a signal to renewable energy developers, housing developers and community energy groups that the area is a positive planning environment for renewables, encouraging them to develop energy projects in the locality. It also sends a useful signal to planning officers, councillors and, if necessary, planning inspectors to consider renewable energy applications in light of their contribution to the local target. Finally, for renewable heat in particular, it could provide the necessary impetus to drive a programme of action to support renewable heat delivery.

16.2 Method

We evaluated a high and low scenario for the future growth potential of renewable energy deployment to 2031. The high scenario is based on the Gone Green scenario developed by National Grid as part of their Future Energy Scenarios (FES) to predict potential renewable energy growth under conditions of strong green ambition and a strong economy. The low scenario is based on the FES Slow Progression scenario, which sees strong green ambition, but a weaker economy. As the Welsh policy context is currently supportive of renewables and achieving decarbonisation, we selected the scenarios underpinned by strong green ambition for the potential target scenarios.

The scenarios we developed for Merthyr Tydfil draw on the total available resource as assessed in task E1, the market potential for building integrated renewables in task E2 and the analysis of district heat opportunities in task E4. We used this evidence about resource potential as the baseline, on to which we have then added consideration of current and predicted trends in renewable energy growth, based on the scenarios assessment we recently undertook for Western Power Distribution's south Wales license area, updated with the latest market insights and tailored to the Merthyr Tydfil area.

Table 53: Resource summary and target scenarios for renewable electricity

Technology	Available resource		Current installed capacity		Target scenarios for 2031			
					Low		High	
	MWe	GWh/yr	MWe	GWh/yr	MWe	GWh/yr	MWe	GWh/yr
Onshore wind	49	115.8	1.5	3.5	8.0	19.6	12.5	30.7
EfW	0.0	0.0	0.0	0.0	-	-	-	-
Landfill gas	N/A	N/A	6.2	23.4	3.5	13.2	3.5	13.2
AD	0.01	0.06	-	-	-	-	-	-
Hydropower	0.24	0.5	0.1	0.48	0.1	0.3	0.2	0.6
Building integrated solar	N/A	N/A	2.4	2.6	5.9	5.7	11.2	10.9
Stand-alone solar PV	267	304	-	-	10.0	9.7	20.0	19.4
Total	316.0	420.4	10.2	6.0	27.5	52.7	47.4	79.0
Merthyr Tydfil projected electricity demand 2031						**208**		**228**
Percentage electricity demand in 2031 potentially met by renewable energy resources						**25%**		**35%**

Table 54: Resource summary and target scenarios for renewable heat

Technology	Available resource		Current installed capacity		Target scenarios for 2031			
					Low		High	
	MWth	GWh/yr	MWth	GWh/yr	MWth	GWh/yr	MWth	GWh/yr
Biomass CHP or large scale heat only	6.2 MWth (heat only application) Or 1.4 MWth and 0.69 MWe (CHP)	19.1 (heat only) Or 8.4 (CHP)	0.4	1.2	3.0	9.2	8.5	26.1
Biomass boilers			0.03	0.09	7.9	24.1	16.4	50.4
Anaerobic Digestion	0.036 (heat only) Or 0.011 MWth and 0.01 MWe (CHP)	0.22 (heat only) OR 0.135 (CHP)	-	-	-	-	-	-
EfW	-	-	-	-	-	-	-	-
Heat pumps	N/A	N/A	0.2	0.4	8.6	16.5	14.9	28.7
Solar thermal	N/A	N/A	0.03	0.02	-	-	-	-
Total	N/A	N/A	0.7	444.5	19.4	49.8	39.8	105.2
Merthyr Tydfil projected heat demand 2031						**364**		**368**
Percentage heat demand in 2031 potentially met by renewable energy resources						**14%**		**29%**

Table 55: Assumptions for RE target setting

Technology	Comments	Low scenario notes	High scenario notes
Onshore wind		Low: 3 new 2MW turbines plus one new 500kW turbine	High: 4 new 2.5MW turbines plus 2 new 500kW turbines
EfW	Resource assessment demonstrated lack of available waste		
Landfill gas	Difficult to estimate what the capacity will be at the existing landfill site by 2031 as it will fluctuate over time. No new sites will be opened. We have assumed the capacity will roughly half.		
AD	Insufficient local resource (food, farm or sewage) for new sites		
Hydropower		Low: no new capacity added	High: all potential sites are built out excluding those in close proximity to existing installations (some in BBNPA)
Building integrated solar		Low: equivalent to 6 per cent of homes	High: equivalent to 11 per cent of homes
Stand-alone solar PV		Low: Two 5 MW solar farms built	High: 3 or 4 solar farms built
Biomass CHP or large scale heat only	Resource is based on woodfuel and energy crop assessment; we recognise that installations will be based on factors other than available resource	Low: the smaller of the scenario areas built with biomass powered district heat plus some larger commercial boilers/CHP	High: two of the scenario areas are built with district heat, plus one small retrofit district heat system is installed and some larger commercial boilers/CHP
Biomass boilers		Low: Equivalent of 2 per cent of homes install biomass boilers	High: Equivalent of 3 per cent of homes install biomass boilers
Heat pumps		Low: Equivalent of 3 per cent of homes install heat pump	High: Equivalent of 5 per cent of homes install heat pump
Solar thermal	Although a limited number of installations wil occur, these are not predicted to make a significant contribution to energy generation due to their small scale and limited applicatio (hot water only in general).		

16.3 Notes on the scenarios

Neither of the scenarios sees renewable technologies achieving their maximum resource potential. However, that does not mean they are not ambitious or easy to attain. Both scenarios can be viewed as challenging and ambitious, yet within reach if steps to support their delivery are taken sooner rather than later. Challenging yet achievable local target setting is an approach Regen believes is best to take for future targets, particularly if the UK is to meet its carbon commitments and future energy needs.

The low and high scenarios forecast a growth in total renewable energy capacity to 47 MW and 87 MW respectively. This results in generation increasing to 104.5 and 184 GWh respectively.

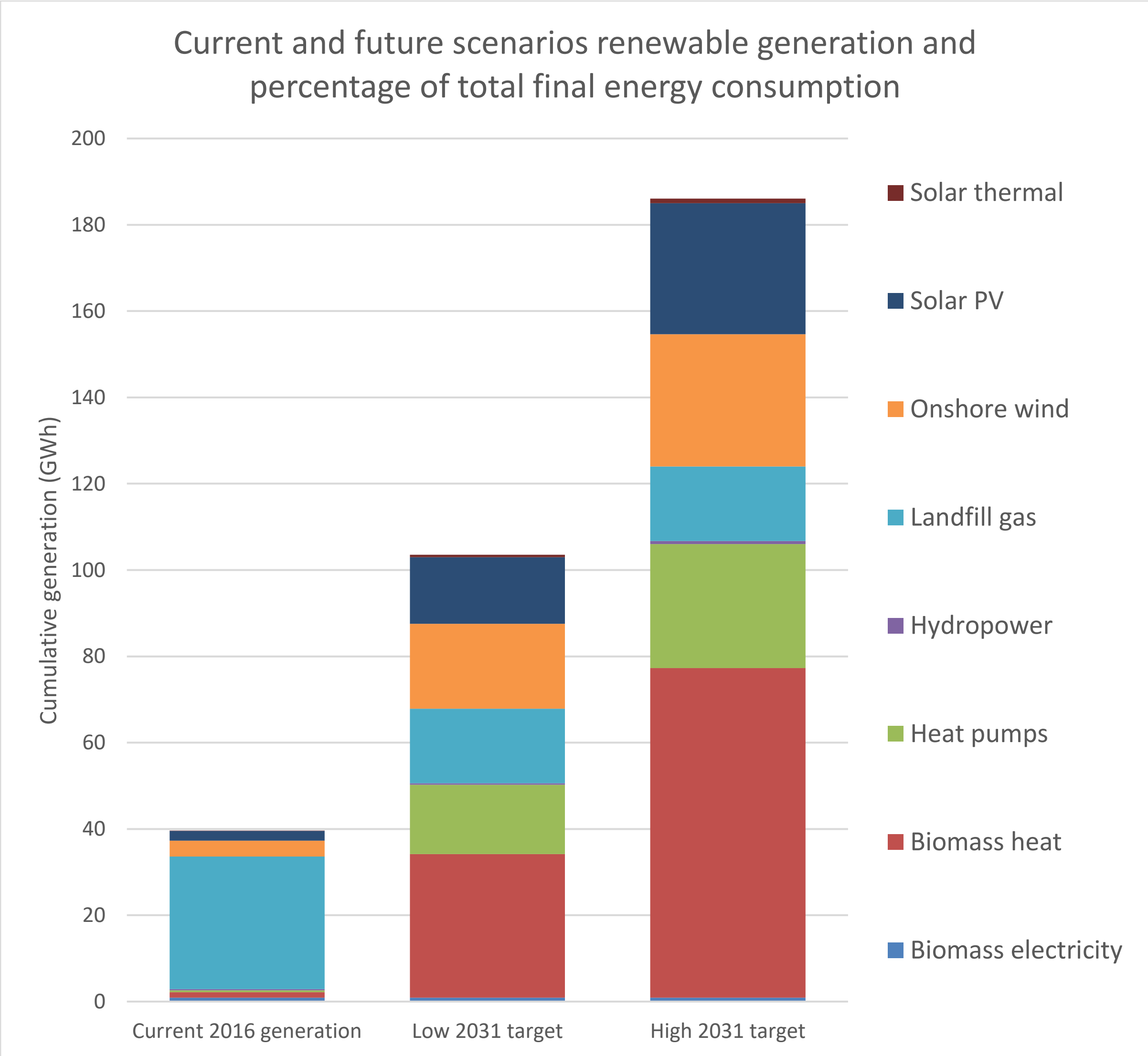

Figure 60: Current and future scenarios renewable generation and percentage of total energy demand

16.4 Communicating a target

Targets can be expressed in terms of installed capacity or as a proportion of energy demand.

The UK's renewable energy target for 2020 is expressed as a percentage of total energy demand (15 per cent of total energy demand from electricity, heat and transport). Expressing the target in this way highlights the importance of energy efficiency and demand reduction; if total energy demand is reduced, then 15 per cent of it is reduced, making the amount of installed capacity required smaller.

In our work with other Councils on setting targets for 2020, we reflected the UK's 2020 commitment and assessed what proportion of local energy demand could be met through local renewable energy generation. Areas using this process tended to set a target of 7.5 per cent of local energy demand being met through local renewable sources, with a further 7.5 per cent coming from national scale renewable projects, such as offshore wind and large scale biomass power stations (in line with government predictions). It should be noted that the UK is currently not on track to meet the fourth and fifth UK carbon budget commitments, or our obligations under the Paris Agreement, so there may need to be an increased focus on local action[36].

With Merthyr Tydfil's Local Development Planrunning to 2031, we feel that a target based on achieving installed capacity is more straightforward and simpler to track than setting a proportion of energy demand. It is also true that as a relatively urban area with limited renewable resources, basing the target on resource rather than demand seems a fairer approach.

However, it is useful to note that currently, the equivalent of approximately 4.4 per cent of total energy demand in Merthyr Tydfil comes from renewables. The low and high scenarios see this increase to approximately 12.3 and 22.6 per cent, provided energy demand also reduces as predicted.

16.5 Delivering the target

Due to the comparatively urban nature of Merthyr Tydfil, renewables associated with buildings play a vital role in the scenarios. In particular, delivery of district heat networks on the potential development areas would make a big contribution to renewable (or low carbon) energy generation in the area.

Likewise, heat pumps and biomass boilers are a key feature of both scenarios and one of the chief challenges of each scenario's deliverability. Whereas renewable electricity deployment has grown steadily across the UK, renewable heat deployment has been slower. Despite the introduction of the renewable heat incentive, domestic and commercial consumers have been slow to switch away from fossil fuel heating, especially in areas like Merthyr Tydfil which are well served by the gas grid. Social housing installation programmes can play a key role in deployment of heat pumps in particular, and commercial and public-sector buildings, such as schools, can play a lead role in the deployment of biomass boilers.

The other key challenges are the deliverability of large to medium scale wind and solar within the local authority. The scenarios are far lower than the total available resource. In particular, we have considered visual impact, cumulative impact and the low level of deployment to date in setting these more modest totals for the scenarios. For a wind project, the visual impact could be relatively large due to the topography of the area; projects would sit towards the top of the ridgelines overlooking the town.

[36] The UK Government is expected to publish an Emissions Reduction Plan to address these issues shortly

Furthermore, such a project may have an impact on neighbouring local authorities and so collaboration with them will be important.

16.6 Electricity network constraints

There are currently significant connection constraints to the electricity network in Merthyr Tydfil. These constraints have arisen, in part, from the cumulative impact of new generation connecting to the distribution network. The growth of distributed generation has led to thermal and voltage limits being reached across much of the South Wales license area, as well as many other license areas across Great Britain.

The main 132 kV electricity line into Merthyr Tydfil from the west has reached its thermal capacity with regards to generator connections and is due an upgrade soon. In addition, the 'bulk supply point' substation transformers in Merthyr Tydfil have reached their thermal capacity. Furthermore, a Statement of Works must be submitted to National Grid to assess the potential impact of new connections to the national electricity transmission system. It is worth noting that although a Statement of Works request must be made for all new connections, they have currently had no impact on wind and solar projects.

While these constraints are significant for the next several years, they do not rule out new connections in the future. Despite the current network constraints, we do not believe it is necessary to temper future renewable energy targets based on such difficulties. There are a number of solutions that the District Network Operator WPD is currently exploring for how the network constraints could become less significant barriers to future projects. These include:

- Active network management
- Alternative connections
- Strategic investment
- Queue management (network availability improves if accepted but not yet connected projects do not go ahead)
- Future flexibility markets
- Developers pay for network reinforcement (business as usual)

Also, in the nearer term, WPD are surveying the 132 kV lines leading to Merthyr Tydfil for reprofiling, as they are doing across much of their South Wales license area. Reprofiling involves allowing existing cables to operate at higher temperatures, often from 50°C to 75°C. In doing so, the cables can sag a number of metres lower, and so the route must be surveyed to check this is safe for them to do so and that there are no obstacles in the way. If it is possible to reprofile the lines, at least 10 MW could be become available in the nearer term.

16.7 Energy efficiency and demand reduction

Although achieving an increase in renewable energy deployment is an important issue, the importance of energy efficiency measures and overall demand reduction should not be forgotten. The area could set a "sister" target to reduce energy consumption by a certain percentage by 2031, e.g. reflecting the Gone Green scenario developed here where energy demand reduces by 16 per cent.

16.8 Next steps

Setting a target for renewable energy deployment is not simply a technical exercise in assessing the deployable resource; it is about creating a target that local people and stakeholders believe in and aspire to achieve. Our experience is that for targets to be meaningful, they need to have buy-in from local authority officers, councillors, renewable energy installers, community groups and the wider public. Therefore, the Council should consider the implications of the scenarios in the SA process and consult with local stakeholders and the public before the content of the deposit LDP is determined.

17. P2 Inform site allocations

17.1 Method

As part of task E1 and E3, we have already reviewed the wind and solar opportunity areas and district heat opportunity areas against potential development areas. Here, we highlight the opportunities for private wires and any potential clashes between renewable energy opportunity areas and new developments.

17.2 Results

Figure 61, Figure 62, Figure 63, Figure 64 below show the opportunities for solar, wind and district heat near the 3 potential development areas with potential to be included in MTCBC LDP.

17.2.1 Project Heartland (Former Ivor Steel Works)

The smallest potential development area considered, Project Heartland, is surrounded by existing residential areas. The closest potential solar and wind resource is located nearer to the larger, mix-use Goat Mill Road potential development area; therefore, any potential generation would be more suitably located near the Goat Mill Road area.

There is some potential for additional solar and wind to the north of Project Heartland as shown in Figure 61 below. However, several applications for large wind projects (3-10 turbines) have already been refused in this area due to the visual impact on the nearby National Park. Any project installations will be difficult due to the exposed and overlooked nature of the resource area.

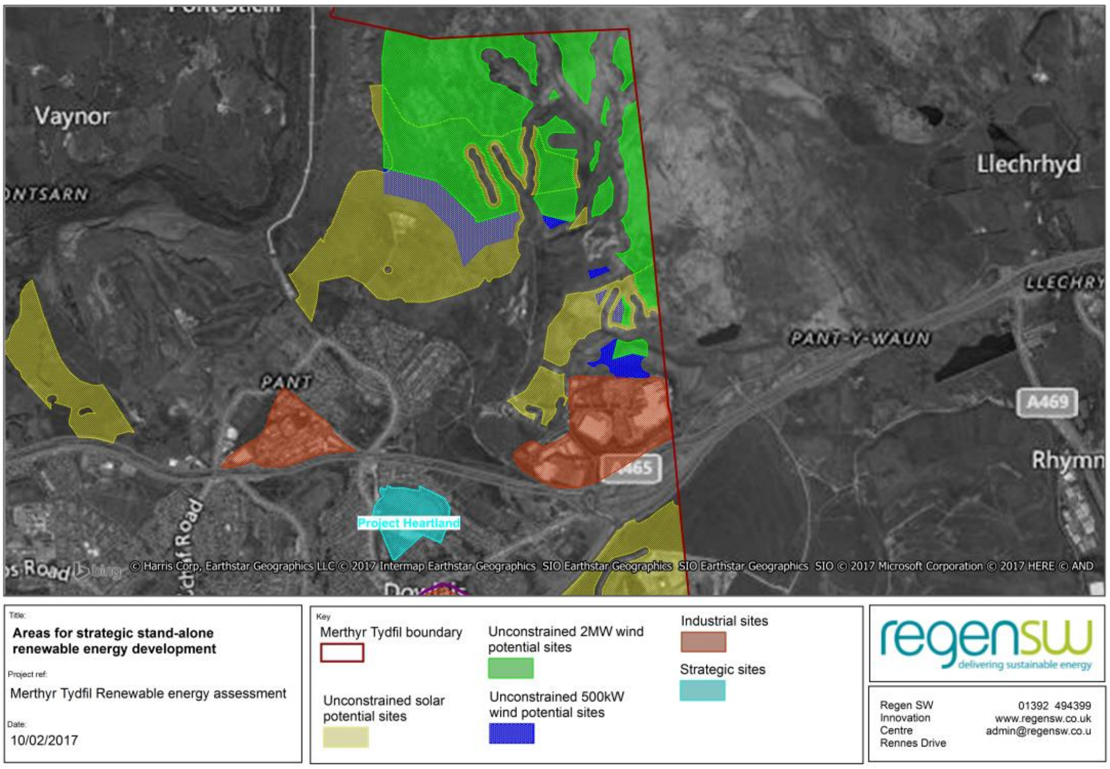

Figure 61: Project Heartland potential generation opportunity

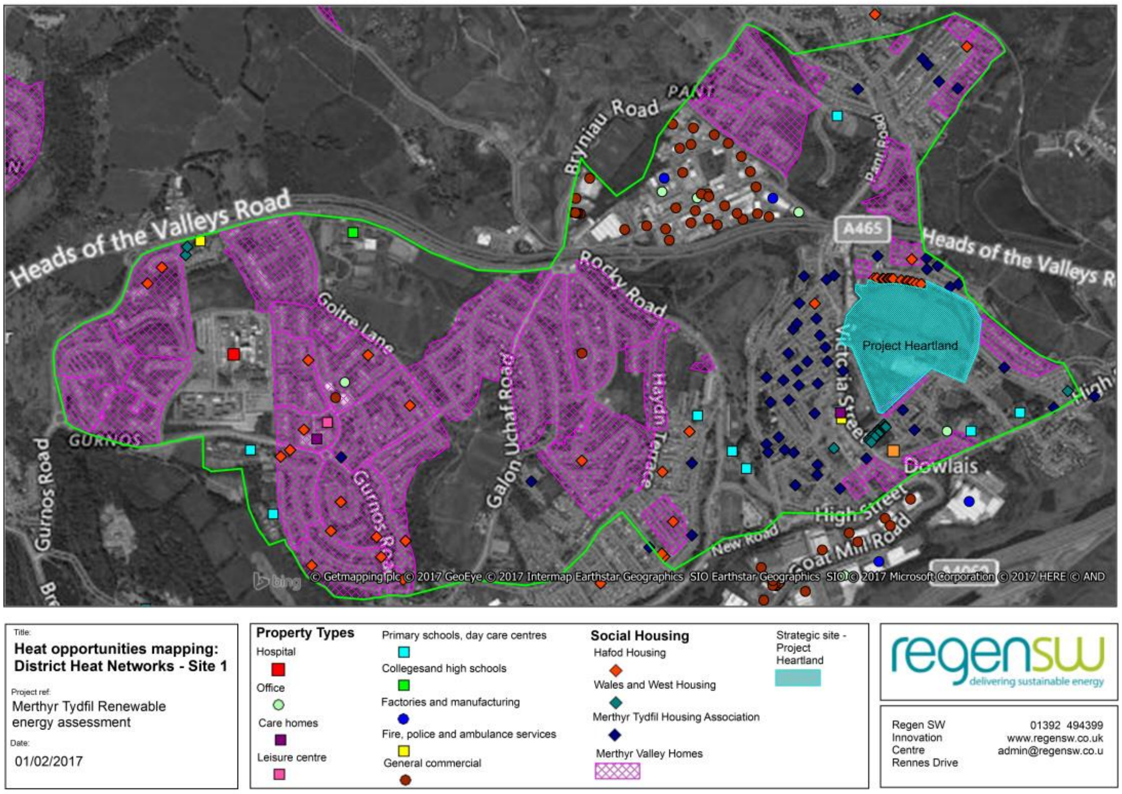

Figure 62: DHN opportunity with Project Heartland

Project Heartland was considered as part of the wider opportunity for a district heat network at Area 1, as shown in Figure 62. Findings from the heat mapping and viability assessment scored Area 1 favourably; however, the most suitable scenarios did not include the Project Heartland potential development area, instead focusing on the demand at Prince Charles Hospital and Pen-Y-Dre Secondary school, to the west of the area. More discussion on this opportunity can be found in section 12.

17.2.2 Goat Mill Road

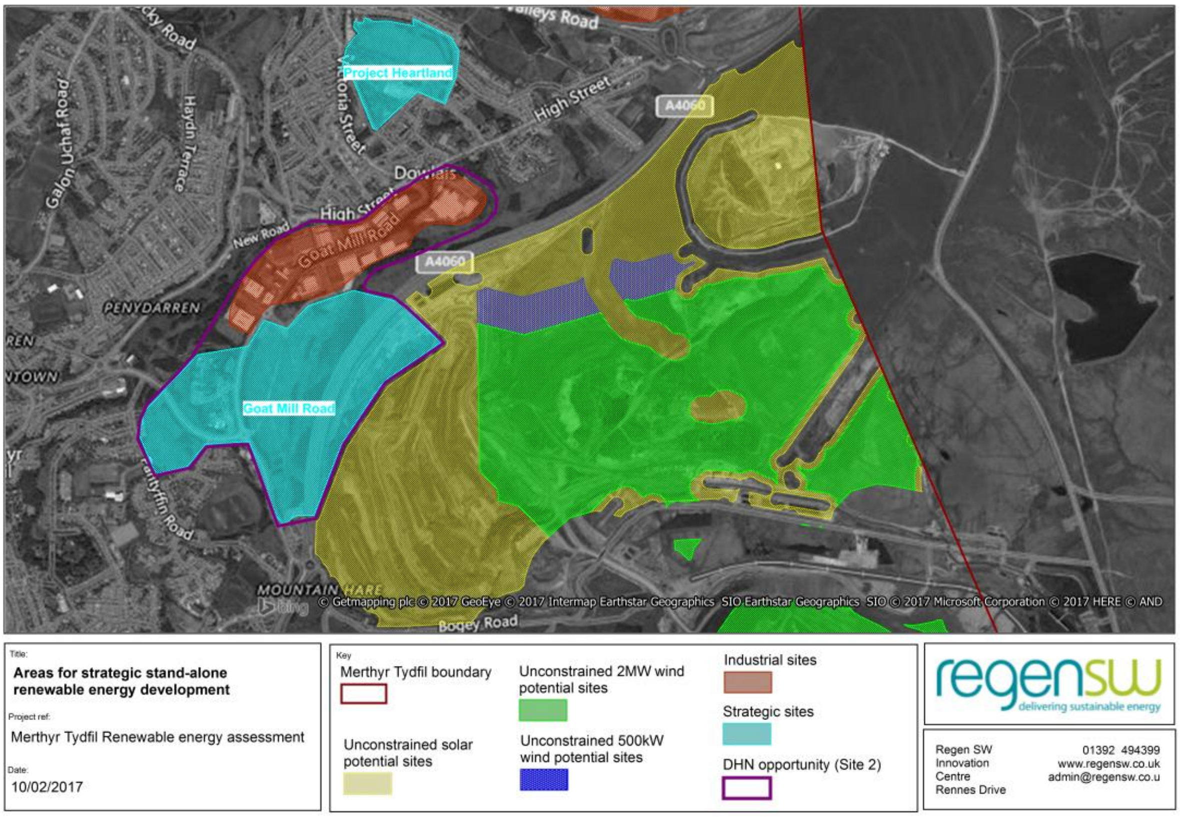

Figure 63: Goat Mill Road potential generation opportunity

- Goat Mill Road potential development area could potentially accommodate a mixed used development with approximately 5-6 hectares of employment land (B uses) and up to 400 new dwellings.
- This area has co-location potential with resource for both wind and solar, although the restoration of the former Ffos-y-fran is a significant consideration and would need more detailed technical site analysis.
- Visual impacts will need consideration due to the proximity to existing residential areas. However, the existing site is a land reclamation scheme and there will be commercial development close to the existing industrial site.
- A district heat opportunity was identified during the mapping and viability assessment; however, other areas scored more favourably.
- For the potential development area, residential electricity demand totals 1,934MWh. The potential for a maximum of either a 10MW solar farm or three 2MW wind turbines, or a co-location site could each provide enough resource to meet electricity demand from the development. (Based on current electricity network and resource conditions)

- The estimated total heat demand for the potential development area is 7,587MWh; this could be partially met by a DHN. Details on this area were examined in the district heat mapping and viability assessment (section 12 and 15). Despite the significant loads estimated for the chocolate factory and S&G print works, the modelling indicates that there is still insufficient kWh available to support a large heat network that could engage with the new 440 homes. If it could be shown that one or more of the anchor loads has more heat demand than we estimated, this development could become viable.

17.2.3 Hoover/Dragonparc

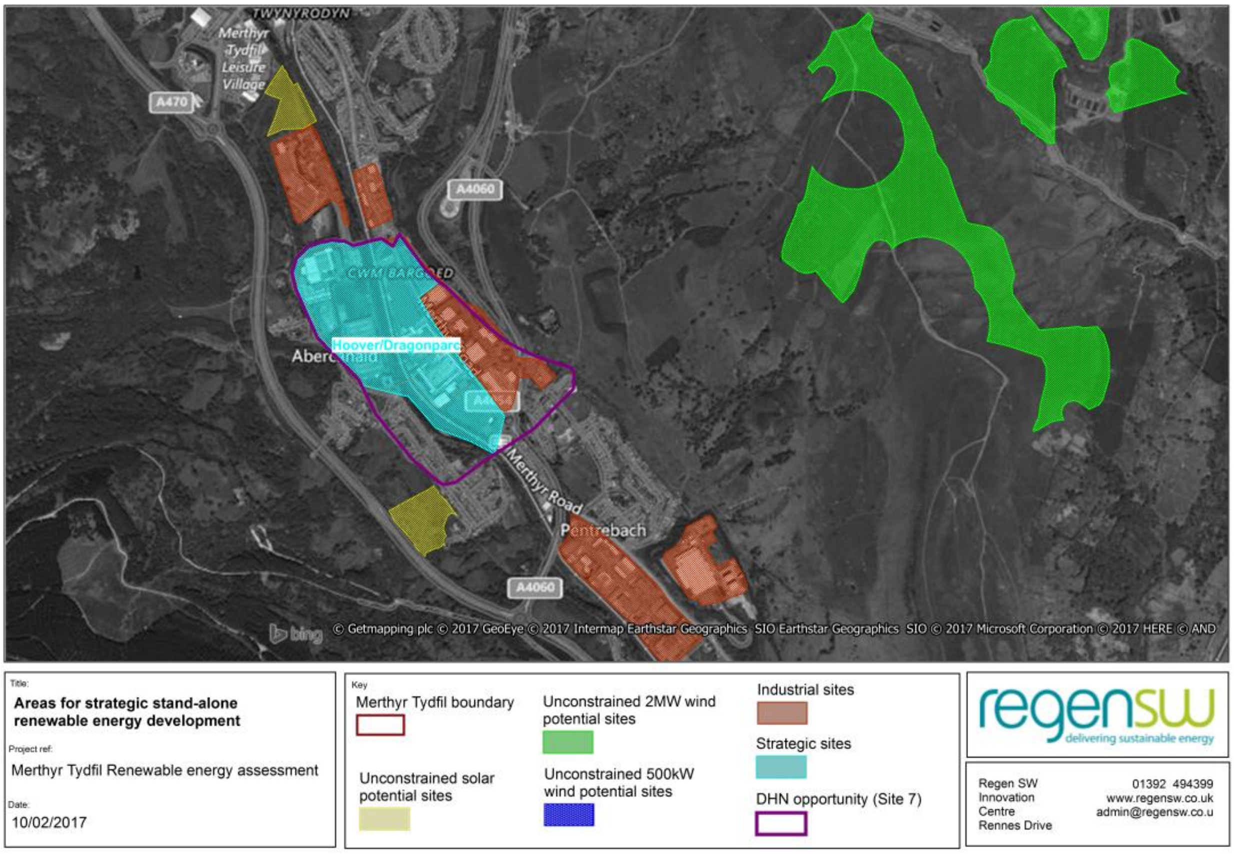

Figure 64: Hoover/Dragonparc potential generation opportunity

- The potential development area could contain up to 800 homes and 60,000m^2 of non-domestic development.
- There is potential solar and wind resource within close proximity.
- Once completed, total electricity demand for the potential development area is estimated to be in the region of 3,413 (MWh); this could all be met by a 5MW solar park or a 4MW (2 turbine) wind farm, or a mixture of the two technologies based on current electricity network and resource conditions. Each option generates sufficient electricity to meet demand of the new development; surplus could be used on the existing nearby industrial and commercial areas.

- Total heat demand for the area could potentially be approximately 13,969MWh. A district heat opportunity was identified in the Hoover/Dragonparc area during the mapping and viability assessment; however, other areas scored more favourably. The modelling indicates that this development does not offer good grounds for supporting a heat network, primarily down to the lack of anchor loads in the vicinity, remembering of course that these anchor loads are desktop estimates. Should the anchor loads for the factories be significantly higher, or new high demand move into the area, then this scenario may well prove viable.

18. P3 Identify opportunities and set targets for renewable energy on potential sites

18.1 Results

The following section sets out the areas identified with potential for 5-25MW wind sites and 5-50MW solar farms or biomass CHP schemes. Clustering opportunity areas identified in E1 into 7 key areas.

The following areas suggest good potential for renewable energy developments:

- High demand and co-location sites – private wire opportunities
    - Area 1 Goat Mill Road
    - Area 2 Pant
    - Area 3 Heads of the Valleys Road
    - Area 4 Hoover/Dragonparc
    - Area 5 Trelewis
    - Area 6 Bedlinog
- Council owned land with solar/wind resource
    - Area 7 North of Heads of the Valleys Road

Specific location details are shown in the maps below (Figure 65 - Figure 71). For district heat opportunities, area 1 and area 6 were identified as the most favourable. See section 12. E3 Heat opportunities mapping and section 15. E4 Task 4: Assessing the technical feasibility and financial viability of DHNs for more details.

18.1.1 Area 1 Goat Mill Road – Mixed use

This potential resource includes both wind and solar and is located near the existing industrial area at Goat Mill Road which has a collectively high demand from several printing companies and the OP Chocolate factory. Alongside this, the Goat Mill Road area could accommodate a mixed used development with approximately 5-6 hectares of employment land (B uses) and up to 400 new dwellings.

The energy demand here suggests opportunity for a private-wire agreement; however, further technical considerations need to be made as this resource covers the Ffos-y-Fran Restoration area. The Ffos-y-Fran Restoration Strategy (2024) and Aftercare (+5yrs) area is not expected to be completed until 2029.

The technical ability of the restored landform (which is intended for grazing, and would not be compacted) to be stable enough to take the pressures of rotating turbine bases and their associated infrastructure would need to be assessed, along with the increased ground compaction affecting agreed and planned water runoff rates from the area.

Solar and wind projects have been developed on former opencast mines. An example of this in Wales is the Maesgwyn wind farm, located in Neath Port Talbot County Borough. The majority of the site area is former opencast coal mine restored to forestry and agriculture land uses. The mining history of the area meant ground improvement works were required ahead of construction of the wind farm on opencast backfill material. The wind farm has 13 2 MW turbines, suitable for the rugged topographical site conditions.

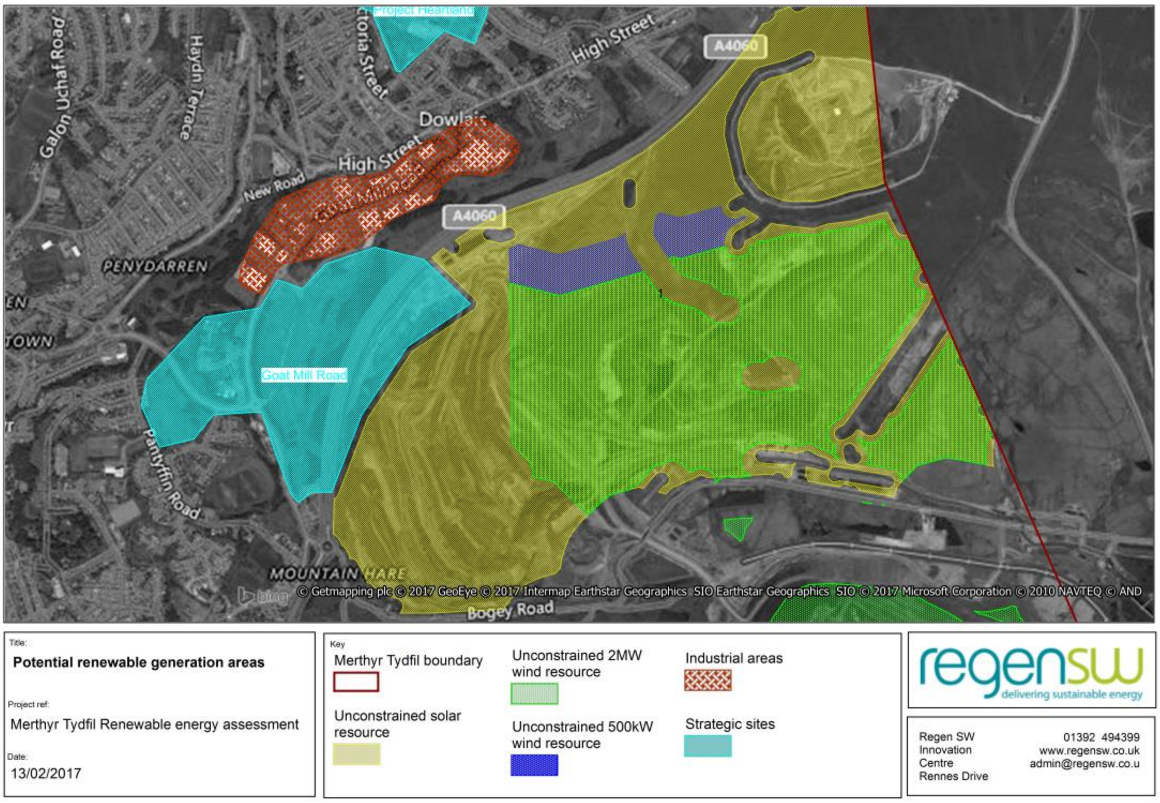

Figure 65: Area 1 Goat Mill Road

Table 56: Potential installed capacity for Area 1

Solar resource area (km²)	Total potential solar capacity (MW)	Wind resource area (km²)	Total potential wind capacity (MW)	Suggested solar capacity (MW)*	Suggested wind capacity (MW)*
2.57	50	1.08 (2 MW turbine)	10	10	6
		0.1 (500 kW turbine)	1		

*Although the resource areas have a much higher theoretical capacity, we have used a more realistic project capacity installation figure for each opportunity.

18.1.2 Area 2 Pant – Mixed use

Industrial areas including Pengarnddu Industrial Estate to the south of the resource area offer potential private wire opportunity.

However, there is already one operational 500 kW turbine and another 230 kW turbine with planning permission approved at the Pengarnddu Industrial Estate. This area will quickly reach capacity as resource at the top of the site is in close proximity to the National Park and therefore several sites have had planning permission refused.

This resource area could link up with Welsh Water's Pontsticill site; however, the energy manager did highlight that current opportunity for co-location wind and solar at the Pontsticill site is limited due to grid constraint issues in the area.

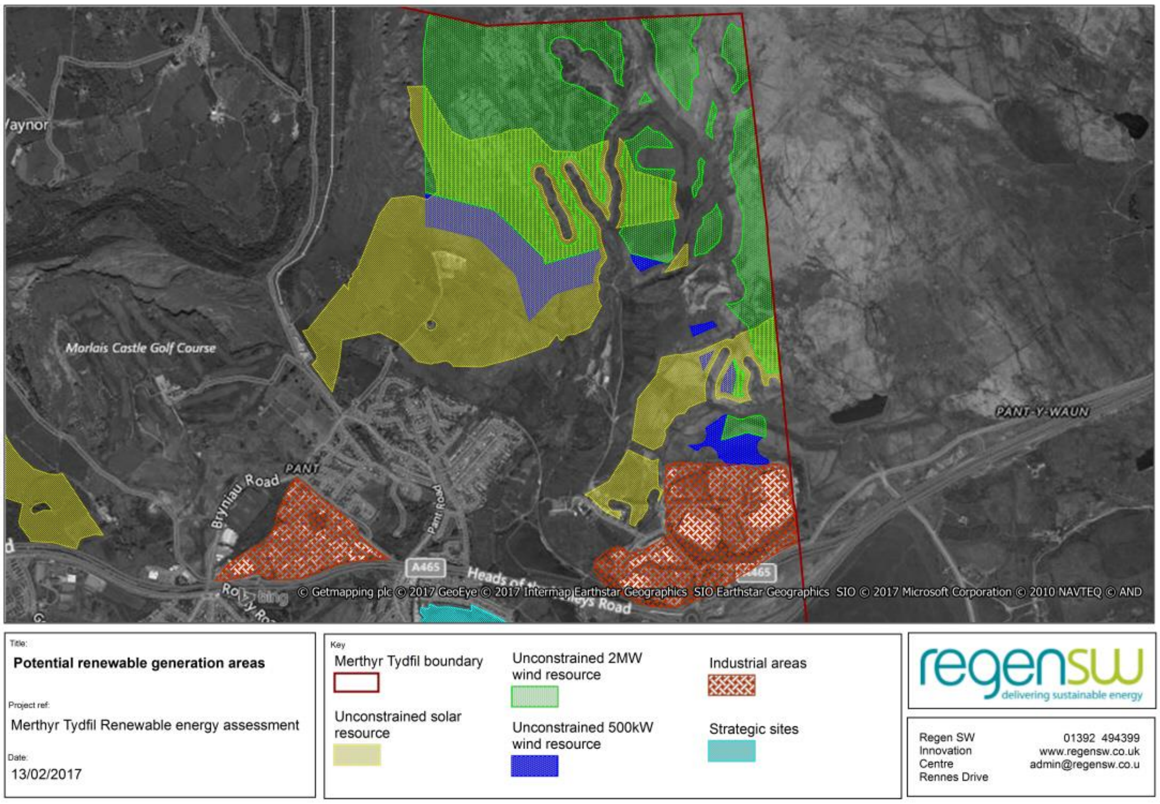

Figure 66: Area 2 Pant

Table 57: Potential installed capacity for Area 2

Solar resource area (km²)	Total potential solar capacity (MW)	Wind resource area (km²)	Total potential wind capacity (MW)	Suggested solar capacity (MW)	Suggested wind capacity (MW)
1.3	50	1.057 (2 MW)	10	10	2
		0.19 (500 kW)	1.5		

18.1.3 Area 3 Heads of the Valleys Road – Residential

There is opportunity for both wind and solar projects in this area. As the site areas overlook a large residential area with a golf course to the north, the solar opportunity may be favoured over locating wind turbines here.

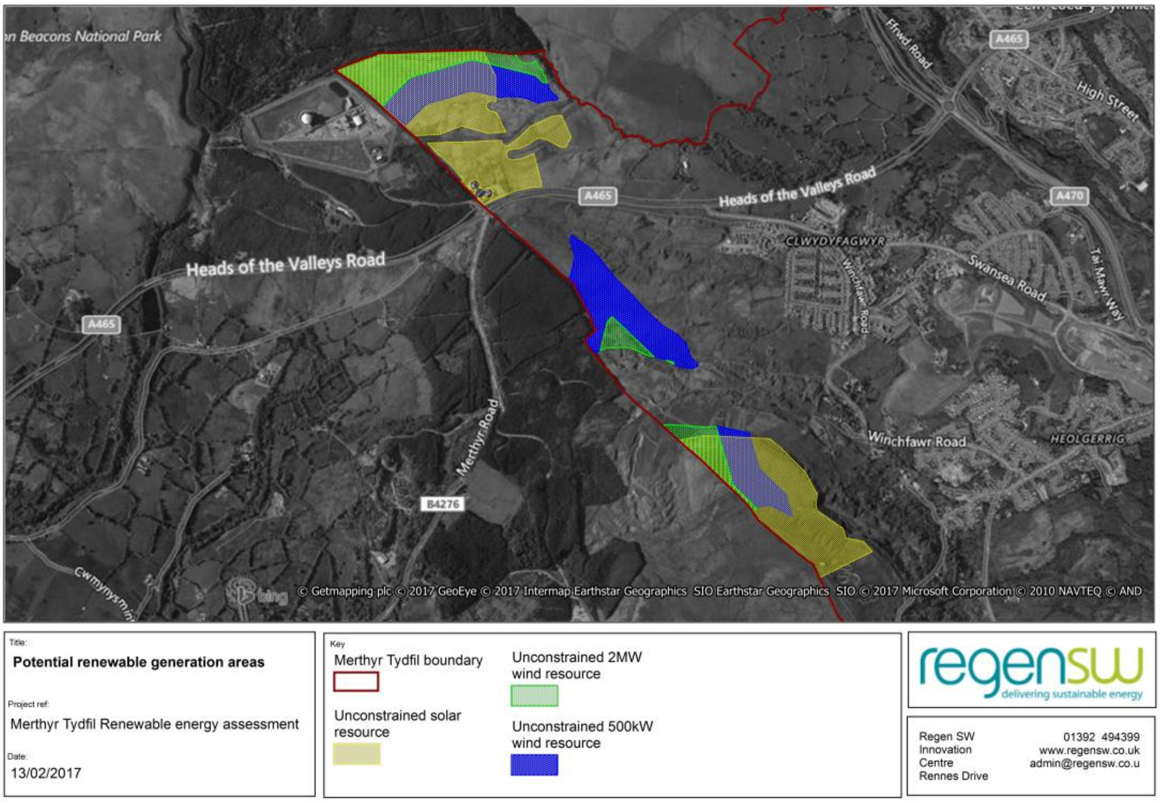

Figure 67: Area 3 Heads of the Valleys Road

Table 58: Potential installed capacity for Area 3

Solar resource area (km²)	Total potential solar capacity (MW)	Wind resource area (km²)	Total potential wind capacity (MW)	Suggested solar capacity (MW)	Suggested wind capacity (MW)
0.57	23	0.16 (2 MW)	2	10	2
		0.3 (500kW)	1.5		

18.1.4 Area 4 Hoover/Dragonparc – Mixed use

This potential resource includes both wind and solar and is located near the existing industrial area Pentrebach, alongside this the Hoover/Dragonparc potential development area, which will be a mixed used development with approximately 3-4 hectares of employment land (B uses) and up to 800 new dwellings. The wind resource is approximately 1.5km from the potential development area. The visual impact of turbines would need consideration, as the resource area is quite exposed and overlooks the residential areas in Pentrebach and Abercanaid.

The existing and new energy demand here suggests opportunity for a private-wire agreement.

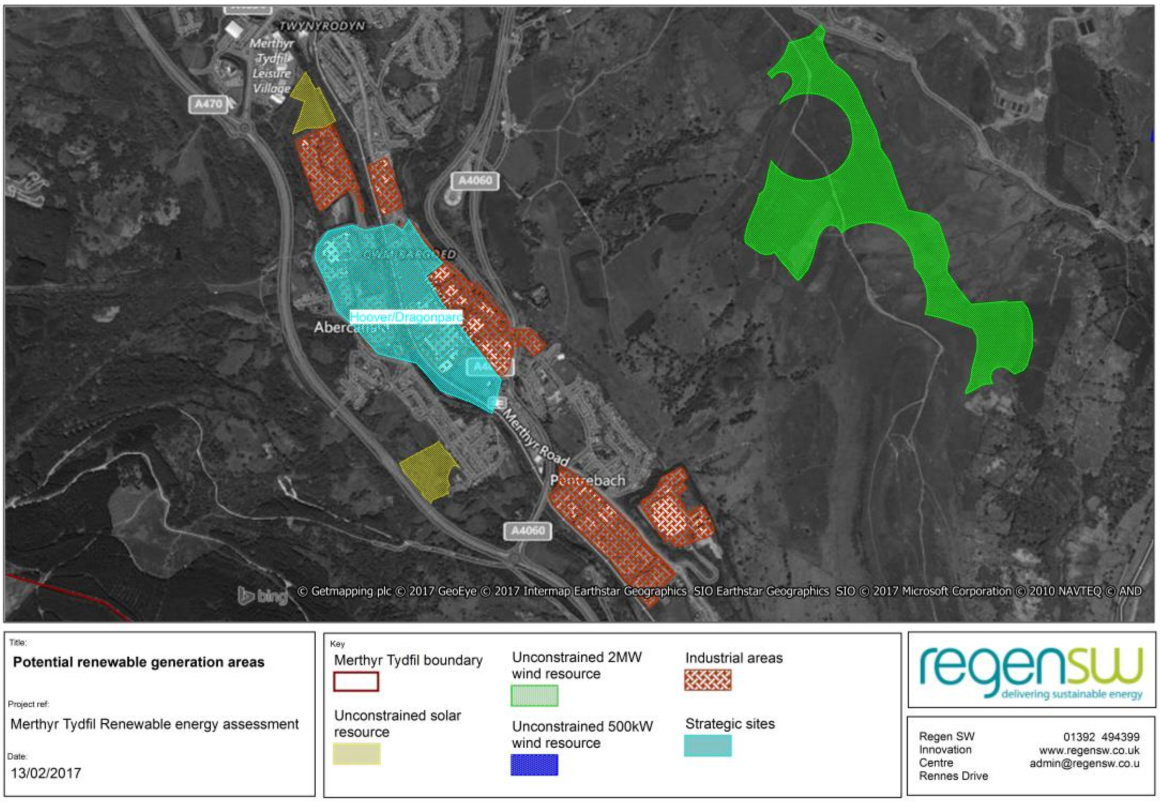

Figure 68: Area 4 Hoover/Dragonparc

Table 59: Potential installed capacity for Area 4

Solar resource area (km²)	Maximum potential solar capacity (MW)	Wind resource area (km²)	Maximum potential wind capacity (MW)	Suggested solar capacity (MW)	Suggested wind capacity (MW)
0.07	3	0.52 (2 MW)	5	3	4

18.1.5 Area 5 Trelewis – Residential

This area provides a large potential solar resource to the east of Trelewis, with an existing residential area nearby. There is a large solar site just across the local authority boundary in Caerphilly. The Hendai solar farm is a 13.5 MW project and provides a community benefit fund to Gelligaer Community Council. Due to this existing site additional capacity in this area could be limited.

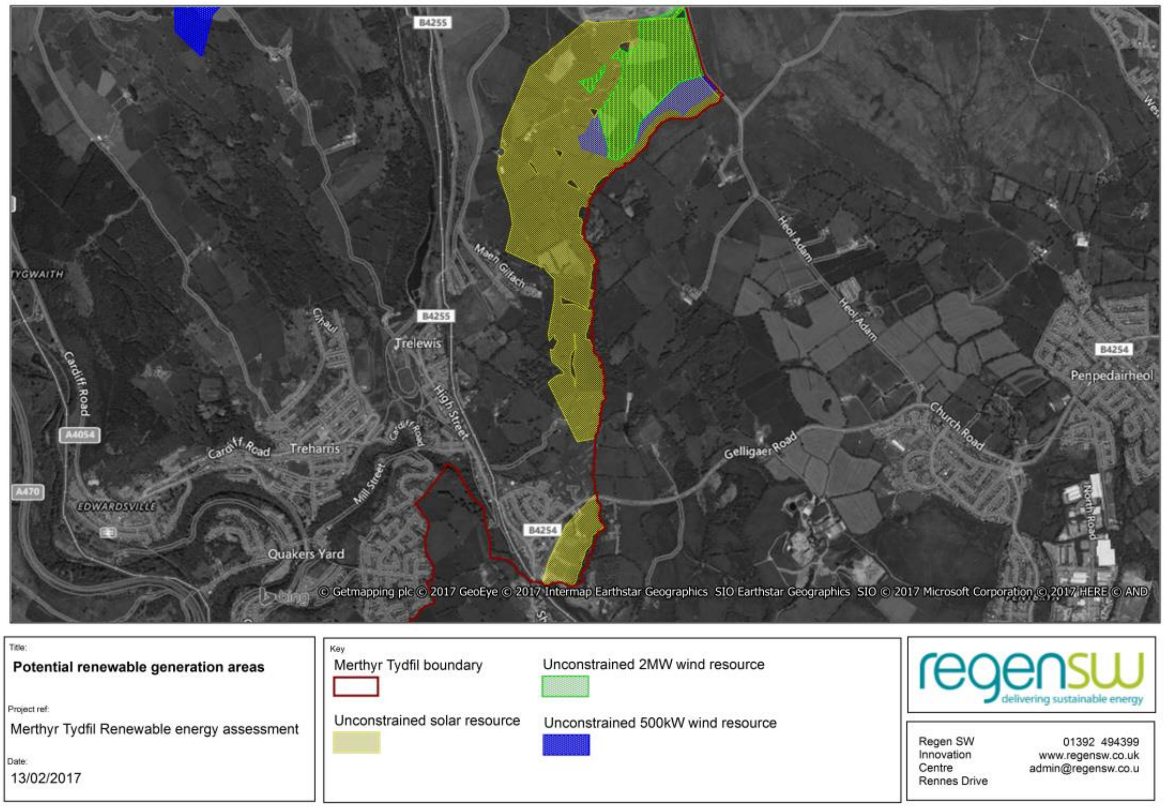

Figure 69: Area 5 Trelewis

Table 60: Potential installed capacity for Area 5

Solar resource area (km²)	Maximum potential solar capacity (MW)	Wind resource area (km²)	Maximum potential wind capacity (MW)	Suggested solar capacity (MW)	Suggested wind capacity (MW)
1.21	50	0.25 (2 MW)	2.5	10	2
		0.1 (500kW)	1		

18.1.6 Area 6 Bedlinog – Residential

The area North of Bedlinog has good resource for both wind and solar projects. There is also potential for a hydropower scheme in the area. The Council suggested there may be an opportunity to support the community energy group in Bedlinog to make the most of this resource. However, an application for three wind turbines in the area was refused in 2013; this would have to be considered for any future project to go ahead.

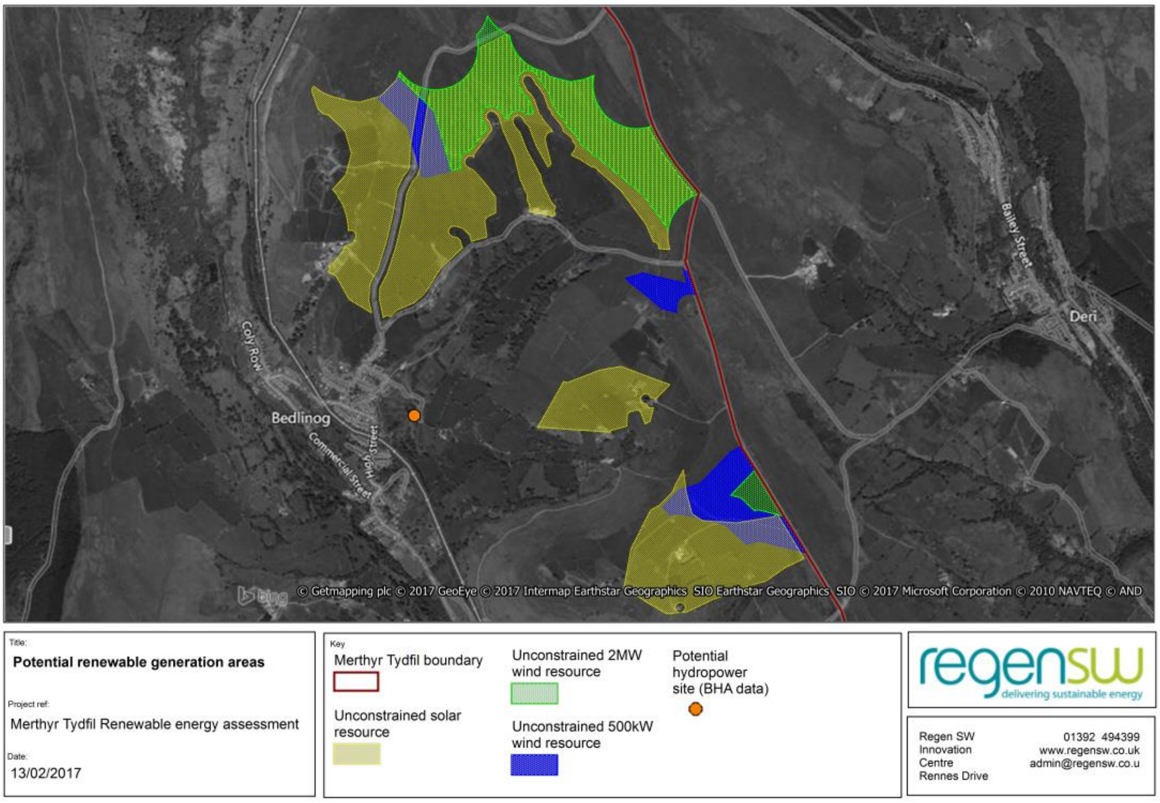

Figure 70: Area 6 Bedlinog

Table 61: Potential installed capacity for Area 6

Solar resource area (km²)	Maximum potential solar capacity (MW)	Wind resource area (km²)	Maximum potential wind capacity (MW)	Suggested solar capacity (MW)	Suggested wind capacity (MW)
1.37	50	0.37 (2 MW)	8	10	6
		0.23 (500kW)	1.5		

18.1.7 Area 7 North of Heads of the Valleys Road – Mixed use

The area just north of Heads of the Valleys Road has potential for solar developments, with additional demand from the Pant industrial area, 0.6km from the resource area. However, the proximity of this resource to large residential areas and the golf course, could limit the capacity potential of this site due to the visual impact. As shown in Figure 71, some of the resource area is under Council ownership.

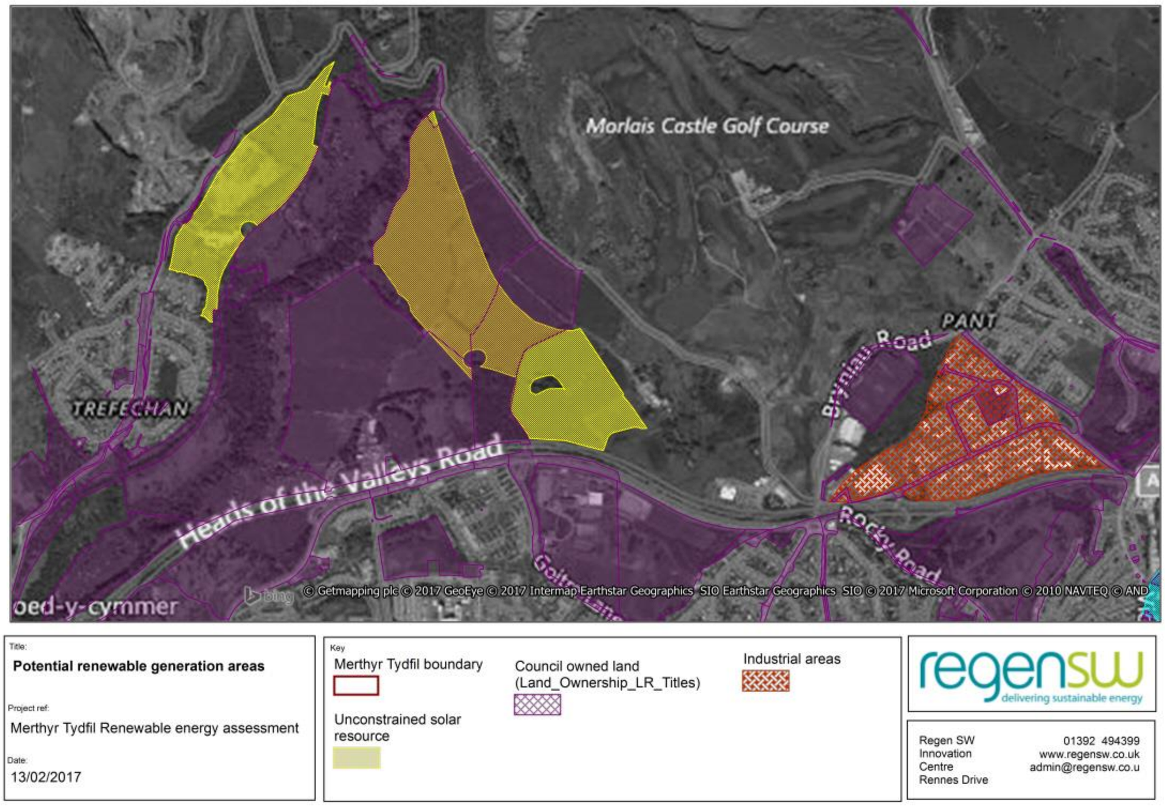

Figure 71: Area 7 North of Heads of the Valleys Road

Table 62: Potential installed capacity for Area 7

Solar resource area (km²)	Maximum potential solar capacity (MW)	Suggested solar capacity (MW)
0.34	14	10

18.2 Next steps

As part of the development of the Local Development Plan, the Council should undertake a detailed assessment, through the plan appraisal processes on the areas identified. Options sufficient to meet the renewable energy targets should be included in the Deposit Local Development Plan, encouraging applications to come forward in those areas from developers and community groups and facilitating the planning process once applications are made.

A capacity target for each area could be set through this process based on the maximum potential for solar and/or wind. However, it is our view that setting a capacity target is not necessary; the scale of renewable development in each area would be determined by the applications that come forward, rather than by a target. In addition, care should be taken when consulting on the areas to highlight that maximum potentials identified would not necessarily be deployed; these figures could be removed to avoid causing unnecessary concern that very large-scale projects are planned to cover the entire areas.

19. P4 Identify opportunities and requirements for renewable or low carbon energy generation linked to new build potential development areas

Using the evidence created in tasks E1-E4, the following paragraphs set out the potential planning policy options for the Council to consider for the potential development areas examined. There are four potential policy opportunities to consider, which interact with each other.

1. Higher energy efficiency standards
2. Near site renewable energy
3. On site renewable energy
4. District heat (see following section)

19.1 Higher energy efficiency standards

Current building regulations in Wales are for an average 8 per cent greater efficiency than the Part L of Schedule 1 of the Building Regulations 2010 standard. The Planning and Energy Act of 2008 enables Welsh authorities to set higher energy efficiency/carbon reduction standards for new build developments. This assessment is focused on renewable energy policies and as such has not explored the viability of higher energy efficiency standards for the areas. However, this is the most direct and long term approach to reducing carbon emissions from the areas.

19.2 Near site renewable energy

Goat Mill Road and Hoover Dragonparc were the two areas to have wind and solar resource identified nearby, as set out in section 17 and 18. Although Project Heartland had some resource to the north, the existing residential area surrounding the small resource area and the challenge of constructing projects near the National Park boundary limit opportunities for near site generation.

The near site opportunities identified, offer significant potential for carbon savings as set out in Table 63 and Table 64:

Table 63: Goat Mill Road generation opportunity and carbon savings

Solar resource area (km²)	Suggested solar capacity (MW)*	Solar generation (MWh)	Potential electricity demand for the site (MWh)	Annual carbon savings (tonnes)[37]
2.57	10	11,388	1,934	4,692
Wind resource area (km²)	**Suggested wind capacity (MW)**	**Wind generation (MWh)**	**Potential electricity demand for the site (MWh)**	**Annual carbon savings (tonnes)**
1.08	6 (3x 2MW turbines)	14,191	1,934	5,847

[37] We have used the total consumption emission factor for electricity (inc transmission losses, CO_2, CH_4, N_2O) https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016

Table 64: Hoover/Dragonparc generation opportunity and carbon savings

Solar resource area (km²)	Suggested solar capacity (MW)	Solar generation (MWh)	Potential electricity demand for the site (MWh)	Annual carbon savings (tonnes)
0.07	3	3,416	3,413	1,408
Wind resource area (km²)	**Suggested wind capacity (MW)**	**Wind generation (MWh)**	**Potential electricity demand for the site (MWh)**	**Annual carbon savings (tonnes)**
0.52	4 (2x 2MW turbines)	9,461	3,413	3,898

**Although the resource areas have a much higher theoretical capacity, we have used a more realistic project capacity installation figure for each site.*

Using planning policy to encourage the development of private wire arrangements where near site opportunities exist can be difficult, as the land suitable for renewables is often outside of the ownership of the developer. The success of any such arrangement is often dependent on factors that are therefore beyond the control of the developer. However, there can be advantages to this approach, enabling a third party to deliver a renewable energy solution rather than adding a cost directly to the developer. The Council could therefore explore the ownership of the potential private wire opportunity sites and the appetite for these to go ahead, both with the land owner and local stakeholders. A planning policy could then be developed to facilitate this opportunity. This could take the form of a specific encouraging provision, e.g. *Developments should demonstrate that they have explored opportunities for private wire arrangements (as identified in section 18. P3).*

Alternatively, a stronger carbon reduction requirement could be introduced. This has the advantage of offering developers' flexibility in how they choose to meet the requirement – through a combination of some or all of the following: on site renewables, near site renewables or district heat networks. It also encourages developers to maximise energy efficiency in order to reduce residual carbon emissions.

Cornwall Council has introduced a policy of this nature in its West Carclaze and Par Docks sites, where the initial evidence base identified opportunities for a near site 8.5MW solar farm and a district heat network. Requirements for these sites include:

- *Meeting all of the regulated energy requirements of the development from renewable and low carbon sources on or near to the site;*
- *Provision of low carbon heat via a heat network*

In a supporting statement justifying the policy, the Council cites:

> *Furthermore, the evidence demonstrates that the energy solution can be delivered at utility (rather than domestic) scale, providing the opportunity for a third party to invest in, deliver and manage the energy supplies of the development, thus removing the burden on the developer that would be associated with a microgeneration only solution.*

We believe this type of policy is justified on the basis that the overall aim of the policy is to reduce carbon emissions from the new development. The UK Carbon Plan (HM Gov, 2011) states that if we are to achieve the 2050 carbon target “by 2050 the emissions footprint of our buildings will need to be almost zero” (page 30). The homes that are built today will still be in use in 2050 when all housing stock must be almost zero carbon. The homes built today must be built with the lowest possible carbon emissions, or they will add to the costly retrofit requirements of our existing building stock over the next 30 years.

Retrofitting is more expensive and therefore less efficient than building to high standards in the first instance; and the cost of retrofit falls either to the owner, or the tax payer where government retrofit programmes are in place.

19.3 Onsite renewable energy

We explored the potential for the Council to introduce an onsite renewable energy policy for the potential development areas considered in this report.

Roof-mounted solar PV is often the most cost-effective delivery option for reducing onsite carbon emissions. Therefore, we have produced a model for PV on the new potential development areas, with the renewable energy generation and potential carbon reduction that this could contribute.

The detailed methodology used is included as Appendix C – Detailed methodology for onsite carbon reduction policy. In summary, we:

- Assessed the potential energy consumption from the sites (E4 Task 2)
- Looked at the generation potential of rooftop solar PV in Merthyr Tydfil
- Investigated the emission factors of electricity and gas to calculate typical total emissions per household
- Calculated the amount of solar PV needed to deliver an emissions reduction target of 10 or 20 percent.

The key findings are that all of the areas considered could achieve 20 per cent carbon reductions if approximately 2kW of solar were installed per household. If a 10 per cent target were set, 1kW of solar would be needed per household. In reality, some homes would have larger systems and some would be built without solar. The calculations below assume these larger systems will be 3.5kW, allowing for some homes to not have any solar.

Table 65: Amount of solar PV to meet an onsite requirement

Potential development area	Number of homes	Solar required for emission reduction (kW)	Number of houses with 3.5 kW installed	Percentage of homes with 3.5

						kW solar in whole development	
		10 %	20 %	10 %	20 %	10 %	20 %
Project Heartland	400	403	806	115	230	29%	58%
Hoover/Dragonparc	800	806	1,612	230	461	29%	58%
Goat Mill Road	400	403	806	115	230	29%	58%

19.3.1 Cost per household

Current installation costs for solar PV on new build houses have been cross checked with two experienced and well reputed solar installers - Sungift Energy and Mole Energy. It was found that a 3.5kW system would cost approximately £3,500 at today's prices. However, as set out in Table 65, not every home would need panels at this scale. As a result, the average additional cost per household of this policy is estimated at just over £1,000 for a 10 per cent requirement and just over £2,000 for a 20 per cent requirement.

These figures can be used in an assessment to determine whether an onsite policy is viable when considered with other development requirements, for example affordable housing requirements or space standards. It should be noted that these costs ought to represent an overestimation because we used standard Ofgem consumption data for all homes in 2015 as the basis for the calculations. New build homes will have lower residual emissions than the 2015 average used, due to improvements to Building Regulations which means the actual cost of delivering the policy should be lower.

Table 66: Estimated costs of an onsite requirement

Potential development area	Number of homes	Number of houses with 3.5 kW installed		Total cost for development at £3,500 per installation		Average cost per household	
		10 %	20 %	10 %	20 %	10 %	20 %
Heartland	400	115	230	£402,959	£805,918	£1,007	£2,015
Hoover/ Dragonparc	800	230	461	£805,918	£1,611,836	£1,007	£2,015
Goat Mill Road	400	115	230	£402,959	£805,918	£1,007	£2,015

It is useful to understand the additional cost burden of a policy to inform the evidence about viability. However, the benefits should not be overlooked:

- there is still a Feed-in Tariff available for new build solar PV, with rates dependent on the installation date and the level of energy efficiency achieved. This tariff could be used either to provide income to the developer, or as an additional selling point for the prospective householder.
- solar panels will reduce the running costs to householders, making the cost of living in the home more affordable.

- an onsite renewable energy requirement can have the additional benefit of boosting the local economy, as housing developers often use local companies to deliver renewable energy requirements; the same tends not to be true of energy efficiency measures.

19.3.2 Policy options

The Council could develop a policy to support delivery of onsite renewable energy. For example, Bristol City Council's policy states:

> *Development will be expected to provide sufficient renewable energy generation to reduce carbon dioxide emissions from residual energy use in the buildings by at least 20%.*

The level of onsite carbon reduction required will depend on the Council's political appetite for the policy; the evidence supports the feasibility of either a 10 or 20 per cent onsite policy.

It is useful to spell out in the policy what the carbon reduction is being measured against and how developers should calculate the carbon reduction achieved. For example, South Gloucestershire Council had their Examination in Public in February 2017 on their Placemaking Plan which includes a 20 per cent onsite requirement. Through discussion with Regen, they decided to include the following clarification of their 20 per cent onsite policy:

For clarity, the baseline against which development will be required to reduce CO_2 emissions by at least 20 per cent is total residual energy consumption, which includes regulated energy use (space heating, hot water, lighting and ventilation) and unregulated energy use (appliances and cooking).

To calculate total residual energy consumption, developers should:

1. *set out the projected annual energy demands for heat and power from the proposed development against the appropriate baseline (the current enacted version of Part L of the Building Regulations (at time of full planning or relevant reserved matters approval))*
2. *reduce this projected annual energy demand further by calculating the additional impact of any further energy reduction and energy efficiency measures incorporated in their design (to meet part 1 of the policy's energy hierarchy). This will give a figure for total residual energy consumption.*

Developers should then demonstrate how they have calculated that the onsite renewable/low carbon measures they propose will generate sufficient carbon savings to offset 20 per cent of the total residual energy consumption.

20. District heat - P5 Develop policy mechanisms to support District Heating Networks (DHNs) for potential new development areas

For new build areas without substantial challenges to pipe routing, such as major roads and water courses, biomass CHP or heat only plants may be suitable to provide the bulk of the heat demand, with gas backup, provided there is sufficient non-domestic load/ to balance the peak evening domestic demand. This study shows that the scale of the potential development areas planned (over 400 new homes), along with some of the larger heat demands that already exist, are potentially a suitable mixture for supporting a DHN, with the most carbon savings achieved when biomass is used to fuel the DHN.

A district heat planning policy could be appropriate to cover the three potential development areas considered in this study, as part of a wider aspiration to lower carbon emissions and increase locally-sourced energy:

- Project Heartland could be a potential location for a heat network if existing non-domestic demand could be connected.
- Goat Mill development could be a potential location for a heat network if the local anchor loads prove to be sufficiently large.
- Hoover / Dragonparc could be a potential location for a heat network if sufficient new non-domestic demand is encouraged to connect at the potential development area, with potential carbon savings of around 1800tCO2e/yr

Examples of strong district heating policy include Bristol City Council's policy (BCS14):

> *The use of combined heat and power (CHP), combined cooling, heat and power (CCHP) and district heating will be encouraged. Within Heat Priority Areas, major development will be expected to incorporate, where feasible, infrastructure for district heating, and will be expected to connect to existing systems where available.*
>
> *New development will be expected to demonstrate that the heating and cooling systems have been selected according to the following heat hierarchy:*
>
> *1. Connection to existing CHP/CCHP distribution networks*
>
> *2. Area-wide renewable CHP/CCHP*
>
> *3. Area-wide gas-fired CHP/CCHP*
>
> *4. Area-wide renewable community heating/cooling*
>
> *5. Area-wide gas-fired community heating/cooling*
>
> *6. Individual building renewable heating*

Bristol City Council has identified heat priority areas through a heat mapping process, similar to that used in this assessment. MTCBC could designate the potential development areas and retrofit opportunities identified as heat priority areas and introduce a similar policy. Bristol's policy is useful in that it includes a hierarchy of preferences for heating options, clearly indicating that area-wide solutions are preferred.

Another example of strong district heat policy is from Exeter City Council's Core Strategy. This policy places the emphasis on the developer to provide the evidence if it believes that a network is not viable.

> *CP13: Decentralised Energy Networks will be developed and brought forward. New development (either new build or conversion) with a floorspace of at least 1,000 square metres, or comprising*

ten or more dwellings, will be required to connect to any existing, or proposed, Decentralised Energy Network in the locality to bring forward low and zero carbon energy supply and distribution. Otherwise, it will be necessary to demonstrate that it would not be viable or feasible to do so. Where this is the case, alternative solutions that would result in the same or better carbon reduction must be explored and implemented, unless it can be demonstrated that they would not be viable or feasible.

An alternative or additional approach would be to include a strong onsite or near site carbon reduction policy; this would also facilitate delivery of district heat networks as district heat networks are one option to achieve carbon savings.

As well as developing an appropriate district heat policy, the Council would need to adopt a positive and proactive approach to working with a developer to facilitate delivery of a heat network. As with near site private wire opportunities, district heat networks can be delivered by a third party to the developer, reducing the burden on the developer. Cranbrook to the East of Exeter is a good example of a low carbon heat network being delivered by a third party (Eon), thanks to significant support and encouragement provided by the Council and others (including Regen).

20.1 Energy strategy requirement

If the Council introduces energy policies for the potential development areas, it will need to consider how to determine whether developments meet the requirements. Developers should be required to submit an energy strategy along with their application. The Local Development Plan should set out what is required in the energy strategy and how the policies are layered on top of each other. Bristol City Council's Core Strategy states:

The energy strategy should:

- *Set out the projected annual energy demands for heat and power from the proposed development against the appropriate baseline (2006 Building Regulations Part L standards[38]), along with the associated CO_2 emissions.*
- *Show how these demands have been reduced via energy efficiency and low carbon energy sources such as CHP and district heating, and set out the CO_2 emissions associated with the residual energy demand.*
- *Demonstrate how the incorporation of renewable energy sources will offset the CO_2 emissions arising from the residual energy demand.*

20.2 Next steps

The Council should consider, alongside other viability matters, the viability of either an area wide or development specific higher energy efficiency standard. This would be the most direct route to reducing carbon emissions from large new developments.

The evidence developed through this assessment supports the case for the Council to introduce higher on or near site renewable or low carbon energy standards. In particular, Goat Mill Road and Hoover/

[38] This could be updated for the Welsh context.

Dragonparc have opportunities for near site wind or solar which mean that a policy requiring 100 per cent of energy demand to come from on or near site renewable or low carbon energy would be possible. The next step in setting this policy would be for the Council to review the near site opportunities and the practicality of their delivery based on the Council's knowledge about landownership.

If the Council decides not to pursue an approach that takes into account the near site opportunities at Goat Mill Road and Hoover/Dragonparc, a 20 per cent onsite renewable energy requirement could be developed for all three potential development areas. Project Heartland did not present near site opportunities and so a 20 per cent onsite requirement would be appropriate. An onsite renewable energy policy is well supported by the feasibility evidence. If the Council decides to take this approach, the cost of around £2,000 per house should be factored into the viability assessments for the sites.

Finally, the potential development areas all showed some potential for district heat networks, depending on the final mix of buildings developed and on the actual heat loads of the surrounding buildings (we used assumed values). The Council could develop a policy requiring district heat networks to be considered for all three areas. This would fit with either a 20 per cent onsite renewable energy policy or a 100 per cent on/near site renewable energy policy. The onus would then be on the developer to either deliver a network or to prove that a network was either not viable or feasible.

21. P6 Identify further actions for the local authority, public sector and wider stakeholders

21.1 Supportive planning policy

As well as specific policies identified through this assessment, the Council should consider writing a general policy supporting the delivery of renewable energy in the area, and setting this within the context of the area's history and its objectives for the future. It should also include criteria for what the Council considers to be suitable projects.

Example policy wording which can be remodelled to achieve this could be:

Merthyr Tydfil has an ambition to reduce carbon emissions in order to fight against irreversible climate change. In Merthyr Tydfil, we will encourage behavioural change and support the use of renewable energy as a tangible means of reducing our local carbon footprint, where appropriate to do so.

Renewable energy planning applications will be approved if their impacts are (or can be made) acceptable. The following considerations will be taken into account in assessing proposals:

- *(List local considerations – e.g. heritage feature that needs particular consideration, environmental, SLA's etc.)*

A positive renewable energy policy sends a strong signal to landowners, developers, community groups and local authority planning officers and councillors that renewable energy applications are to be welcomed, encouraging sites to come forward to planning. Listing out local considerations in a policy helps these groups to understand the specific features of the local area that have particular value and to choose sites and approaches which consider these; meaning that time is not wasted exploring sites that are not locally appropriate. Policies should add locally specific information rather than simply repeating national guidance.

21.1.1 Local ownership policy

Retaining energy spend in the local area is an important driver of local energy policy. In order to maximise the benefit to the local economy of harnessing local renewable energy resources, ownership of these assets should be considered. By requiring local community ownership of all renewable energy generation, policy can ensure that the benefits of renewables are retained locally, rather than being funneled away by commercial developers.

Example policy wording might be:
Renewable energy development will be permitted where community ownership can be demonstrated.

Other, softer policy wordings are possible; such as wording that encourages local ownership, rather than requiring it. However, if this is a strong driver of local policy, we believe it is important to require local ownership. This can then either be defined with further policy wording to set out what counts as 'community' and what counts as 'ownership', or it can be left open so that it can be determined on a case by case basis. Proposals should however demonstrate that they will be owned by an appropriate community energy enterprise which operates for the benefit of the community (e.g. a

Community Benefit Society) and the development should be constrained by an asset lock or dissolution clause which prevents it from being sold for non-community purposes.

21.2 Own estate

Opportunities for renewables on the Council's own estate are limited due to the amount of land and buildings owned by the Council. However, investment into Council own estate projects have multiple social, economic and environmental benefits. The Council already has several rooftop solar PV systems installed on schools, care homes and the civic centre. We have identified solar resource just north of Heads of the Valleys Road which overlaps with Council owned land. This area would be suitable for a 5MW solar park, although consideration for the proximity to the Morlais Castle Golf Course and residential areas would need to be taken (further location details are shown in Figure 71).

Several of the schools also feature in our DHN assessment; such sites could have stand-alone solar or biomass CHP generation.

In addition, in 2016, the Council's scrutiny committee recommended that the Council produce a Corporate Carbon Management Plan. This could formalise current corporate energy saving actions to produce a comprehensive plan to review and reduce energy use (and carbon emissions from energy use) across the Council's estate. For example, the Council could prioritise potential investments using Salix's no interest loans, or consider working with Re:Fit Cymru to explore energy performance contracting. Procurement policies could be put in place; for example:

- A commitment to replace fossil fuel boilers with low carbon alternatives as they come up for replacement
- A commitment for new Council buildings to meet higher energy standards

Action	Level of Council investment	Return on investment	Social / economic/ environmental benefit	Risk
The Council could develop an investment programme to deliver renewable energy opportunities identified through this assessment	Med	Med	High	Med

21.2.1 Smart energy

Smart grids, enabled by smart appliances and meters, will be crucial to providing greater flexibility in our energy system going forward; balancing energy demand and supply and enabling a more rapid and greater deployment of variable low carbon generation. The National Infrastructure Commission state that 'Smart Power' could save consumers up to £8 billion a year by 2030 and help the UK meet its 2050 carbon targets. The UK government is committed to implementing the "Smart Power" report to make our energy system smarter and more flexible. Our view is this is the key energy policy issue going forward.

Smart/ flexible power is a huge opportunity to support more local and community approaches to generating, supplying and using low carbon energy. By matching supply and demand at a local level you can reduce the need for network infrastructure and centralised (fossil fuel) generation.

The move to smart management of the grid requires better data and intelligence on how the grid is currently being used. The roll out of smart meters is a key part of this. According to Smart Energy GB, the smart grid will:

- better match supply and demand
- enable people to be more efficient and waste less energy
- help energy be more secure and reliable
- mean unexpected power outages can be tackled faster
- allow more accurate long term planning for the energy networks
- better integrate renewable and low carbon technologies, including electric vehicles
- enable time of use tariffs that encourage energy use when energy from renewable sources is plentiful.

Smart meters are due to be installed in every home by 2020. To date, 2.6 million smart meters have been installed across the UK. Over 1.5 million are smart electricity meters and the remainder are smart gas meters. Deployment has increased each quarter, but is falling well short of the volume required to meet the government's aim of every household having a smart meter by 2020.

Smart Energy GB is currently looking for routes to reach vulnerable and hard to reach people to ensure they are not left behind in the smart meter rollout. Councils, housing associations and community energy groups are trusted local intermediaries that could use their voices and relationships with householders to inform people about smart meters and their benefits. The 'Smart Energy GB in Communities Fund' provides grants up to £25,000 per year for local groups (it is currently closed for applications); they could be approached to see if they would fund a Council programme.

A number of trials are underway across the UK that use smart technology. For example, Regen has been working with Western Power Distribution and Wadebridge Renewable Energy Network on the Sunshine Tariff project. The aim was to offer customers a lower tariff in the middle of the day to incentivise them to use electricity at a time when the local solar farms are generating to enable the solar farm to connect to a highly constrained grid. The summary report on the trial is available to download here. Lessons learnt include:

- it is challenging to get customers to switch suppliers and tariffs at present. It is likely to become easier in the future when all customers have smart meters, are half-hourly settled and have more flexible load
- we were testing the viability of an 'offset connection agreement' which would enable more generation to be connected to a constrained network. However, at this time, the results have not made WPD confident that customers would actively switch to a sunshine tariff and provide enough of an offset to overcome grid issues.

Energy Local is also running a trial aggregating demand in Betheseda, North Wales.

Further trials are needed to understand consumer responses to smart technology. This is a very clear direction of travel and the Council, as an energy user, holds data about current energy use on its own estate and is potentially a useful partner for trial smart energy projects, for example through InnovateUK and Horizon 2020 funding routes. Examining options for using our existing energy system in a smarter way also has significant social, economic and environmental benefits for the local area.

Action	Level of Council investment	Return on investment	Social / economic/ environmental benefit	Risk
The Council could investigate funding opportunities to deliver a smart trial in the area, for example, by approaching Innovate UK and looking at current EU funding opportunities.	Med	Med	High	Med
The Council could access the Smart Energy GB in communities fund to deliver a programme for hard to reach households	Low	Low	High	Low

21.2.2 Storage

Access to the grid could be a significant barrier to the potential development of renewable energy capacity in the local area (see section 16.6); however, alongside smart applications, storage offers a potential solution to this in the future which the Council should be planning for.

Regen has recently published a white paper on energy storage, "Energy storage – towards a commercial model". In this paper, we outline 3 prime roles that storage can play in the energy system:

1) **Response –** The ability to respond quickly to support the energy network, by providing rapid response balancing services such as frequency or voltage/reactive power support.
2) **Reserve –** The fundamental property of energy storage that enables energy to be stored and used at a time when it is required. This can manifest itself through back-up supply provision for sites/buildings through to larger scale capacity reserve services, such as Short Term Operating Reserve (STOR).
3) **Price / Time Shift –** The capability to shift energy from lower to higher price cost periods, including the ability to take advantage of price variances (aka price arbitrage) to the avoidance of peak network charges and bypassing grid export constraints.

Over the past year, Western Power Distribution alongside other UK network operators have seen a significant rise in the volume of connection agreement applications for storage projects. This unprecedented level of interest has given rise to some c.2,104MVA of connected, accepted or offered storage capacity on its network.

Whilst other legacy or emerging storage technologies are apparent in the market (e.g. pumped hydro, flow batteries, compress air/liquid air energy storage etc.), the dominant storage technology is Lithium Ion batteries, due to the speed of operation and flexible storage capacity.

The business models and revenue streams driving investment in storage are complex, for an in-depth insight into the current potential for storage read our white paper. Below, we outline some of the applications for storage that may have relevance to the Council at present.

21.2.3 Commercial & industrial applications

For the Council's own buildings, there is a potential business case to deploy storage, either using standalone energy storage systems or co-locating storage alongside onsite generation and demand. This solution offers the ability to store excess generation that would have otherwise been exported to the grid from for example rooftop PV. The storage system can then supply electricity to meet site demand at another time of day. By avoiding peak network charges i.e. TRIADs in the winter or 'red-band' distribution charges, a storage system could provide additional revenue from the generation schemes.

21.2.4 Generation co-location

Standalone generation assets have the potential to co-locate storage with the generation; this may act as a method to bypass or negate export limitation or grid constraints that WPD may enforce if a generation project was to connect on its own. The business case for co-location storage projects (with both generation and demand) is an area that Regen are exploring in detail over the summer, working alongside key industry partners and storage experts.

21.2.5 Domestic & community scale

Batteries for domestic/small scale "generator own use" storage are likely to become viable in the near term as battery prices fall, with the most likely application alongside PV. At present, batteries at the domestic scale are not offering a return on investment for individual households and the market is very small, with early adopters the main customer base, similar to the early days of PV deployment. Storage alongside electric vehicle charging is also likely to be an area of growth in the coming years. There are a number of trials taking place on a multi-household basis, led by community energy groups, local authorities and social housing providers.

21.2.6 Other storage applications

The surge in grid applications for large-scale storage and planning applications for this type of storage are likely to be seen in large numbers by planning departments over the next year or two, particularly on brownfield industrial sites.

Although storage targeting reserve and response grid services, (see National Grid Power Responsive programme), are unlikely to be significant in the Merthyr Tydfil area, as we have discussed above co-location with generation projects could come forward. We believe that dealing with this new type of infrastructure will present new challenges for planners, for example, around visual impact and safety, which need to be tackled through planning and siting measures, and therefore recommend the Council takes a proactive approach to planning for storage.

Image of medium scale battery storage plant from AES Energy Storage

Action	Level of Council investment	Return on investment	Social/ economic/ environmental benefit	Risk
The Council could investigate being a partner with an energy or storage company to trial own use storage, either in its properties, by working with social housing providers or through support for a local community energy group. Regen could facilitate an introduction.	Med	Low	Med	Med
The Council could begin to upskill planners on the issues surrounding storage, with support available from Regen. We can run a bespoke training session to discuss the issues in detail.	Low	Low	Med	Low
The Council could consider if land in its ownership is suitable to host a storage project.	Low	Med	Low	Low

21.2.7 Local supply

Regen produced a white paper on local supply options, which sets out the potential business models for local authorities, housing associations and community groups to consider when looking to sell their electricity locally. To understand the options fully, you should read the paper – follow this link www.regensw.co.uk/local-supply-options-for-selling-your-energy-locally to download a copy.

Bristol Energy is an example of a fully licensed supplier model, established by Bristol City Council. Given the area's size, partnering with an existing supplier might be a more suitable for Merthyr Tydfil, for example, using a white label model to work in partnership with a licensed supplier to offer tariffs under a different brand. White label providers have a contractual agreement with a licensed supplier to sell gas and/or electricity to consumers using the white label's brand.

The right model for the Council will depend on the Council's objectives. Potential objectives might include:

- Generating income
- Addressing fuel poverty, social and health issues
- Accelerating decarbonisation
- Accelerating decentralised generation to create jobs and economic opportunities
- Providing local energy security
- Addressing some other form of market failure like - grid constraints or poor regional service

Councils can also be involved in the sale of heat through a range of models, for example owning and operating a district heat network (or some aspect of it); owning boilers that are installed in buildings owned by other organisations and selling heat (e.g. in schools); or producing and selling woodfuel.

The next steps regarding local supply would be for the Council to discuss and agree what its objectives would be for a local supply model in the area. Regen could run a workshop with the Council to explore potential objectives and models.

Action	Level of Council investment	Return on investment	Social / economic/ environmental benefit	Risk
The Council could investigate appropriate local supply options and take forward a locally appropriate option.	High	High	High	High

21.2.8 Community energy

Community energy has a long history in Wales, recognising the value that engaging communities in their local energy issues can have. However, changes to the availability of local grant funding and the UK subsidy regime have had a negative impact on conventional community energy business models.

Despite this, many of the groups that Regen works with are continuing to pursue ambitious energy projects, with community groups in our network needing support to refocus their efforts in new areas, in particular storage, smart, energy efficiency and local supply. For example, Regen is working on a Friends Provident funded project to support three groups in England to develop new business models for community energy. We will publicise the results of this work widely but our initial research has demonstrated that three potential business models were suitable for further investigation:

1. local supply, particularly demand side response, local balancing and private wire
2. energy storage, particularly co-locating storage with generation and an aggregated domestic storage model
3. community heat networks, particularly small scale heat networks for new build developments and the provision of heat services.

In addition, community business models for solar farms and wind are increasingly more viable than commercial models – so groups can still be successful at implementing more conventional business models. For example, the Local Energy Service published guidance for community groups in 2016 on using refurbished wind turbines. However, community energy groups continue to need support to achieve their aims and rely of support from organisations such as Community Energy Wales.

Regen also runs a Community Energy Accelerator, which offers technical support time and events for community groups. From June 2015 to October 2016, we partnered with Devon County Council to deliver intensive support to Devon communities, in particular offering them support to apply for Rural Community Energy Funding (RCEF), as well as training and events. Devon County Council spent £107,000 on local support, which leveraged in over two and a half times that (£284,608) in grant funding from the RCEF and match funding from our Community Energy Accelerator. We are now replicating this initiative in Dorset under the Power to Change programme.

MTCBC could consider funding local targeted support to community energy groups in Merthyr Tydfil to enable them to deliver projects in this way and leverage in additional resources to the area. For example, support for the community energy groups in Bedlinog, or Friends of Taff Bargoed Park Group could result in new projects coming forward and enable delivery of policies identified through this study. There are a number of organisations able to offer these kinds of services to communities.

Action	Level of Council investment	Return on investment	Social / economic/ environmental benefit	Risk
The Council could provide support to local community energy groups to deliver their community energy ambitions.	Low	Low	High	Low

21.2.9 Leadership

The Council could also consider developing a renewable energy strategy for the area. Drawing on the evidence presented in this assessment about the potential for renewables across the area, the Council could work with other key landowners and public sector bodies to develop actions to facilitate the delivery of the resources identified. The process of developing a strategy would raise awareness of the resource that exists, encouraging landowners, communities and other organisations to deliver renewable energy projects.

In particular, the building integrated renewables market in the area could do with a boost to kick-start deployment, particularly for heat technologies. A programme of installations across the public sector buildings, schools and social housing would support wider deployment in the private sector as householders and businesses become more aware of the technologies. Additional awareness raising activity could also be very valuable in boosting activity, such as a local trade show and accompanying communications campaign.

Action	Level of Council investment	Return on investment	Social / economic/ environmental benefit	Risk
The Council could work with local partners to develop a renewable energy strategy for the area.	Low	Low	High	Low
The Council could drive a public sector installation programme and awareness raising activity.	Low	Low	Medium	Low

Appendix A – Area scoring for DHNs

	Area number 1 - Prince Charles Hospital/Project Heartland	Score 1-9	Weighting 1-5	Total score
1	Proportion of properties off gas grid	0	4	0
2	Proportion of connections on Council owned land (social housing, public buildings etc)	1	3	3
3	Proximity of social housing to anchor load	8	4	32
4	Level of demand from anchor loads (likely scale of demand from building type)			
	Anchor load 1 – Prince Charles Hospital	9	3	27
	Anchor load 2 – Pant Industrial estate	4	3	12
	Anchor load 3 - Dowlais Library	2	3	6
	Anchor load 4 – Pen-Y-Dre High School	6	3	18
5	Suitable physical location for EC	8	3	24
	Council ownership or influenced area	7	4	28
6	Proportion of pipe runs that will be easy/soft dig	5	4	20
7	Proportion of anchor loads under Council control (%)	5	4	20
8	Usefulness of anchor load diversity and demand (demand during night or middle of the day	8	4	32
9	Average level of fuel poverty in the network area (26%)	2.6	3	7.8
10	Assets – (potential waste heat connections)	0	2	0
11	Cost escalators (major roads, rail, water courses, gas main, HV to be crossed)	-3	5	-15
12	Ability for network to serve additional connections	3	3	9
13	Average energy demand density for network area – non anchor load (1914.10 MWh/yr)	8	3	24
	Total area score			**227.8**

	Area number 2 – Goat Mill Road	Score 1-9	Weighting 1-5	Total score
1	Proportion of properties off gas grid	0	4	0
2	Proportion of connections on Council owned land (social housing, public buildings etc)	1	3	3
3	Proximity of social housing to anchor load	3	4	12
4	Level of demand from anchor loads (likely scale of demand from building type)			
	Anchor load 1 – OP Chocolate Factory	7	3	21
	Anchor load 2 – S&G Print Group	3	3	9
	Anchor load 3 – Cords Duaflex	3	3	9
	Anchor load 4 –			
5	Suitable physical location for EC	9	3	27
	Council ownership or influenced area	8	4	32

6	Proportion of pipe runs that will be soft/easy dig	8	4	32
7	Proportion of anchor loads under Council control (%)	0	4	0
8	Usefulness of anchor load diversity and demand (demand during night or middle of the day	5	4	20
9	Average level of fuel poverty in the network area (25.38%)	2.5	3	7.5
10	Assets – (potential waste heat connections)	3	2	6
11	Cost escalators (major roads, rail, water courses, gas main, HV to be crossed)	-3	5	-15
12	Ability for network to serve additional connections	3	3	9
13	Average energy demand density for network area – non anchor load (1868.14 MWh/yr)	8	3	24
	Total area score			196.5

	Area number 3 – Bishop Hedley	**Score 1-9**	**Weighting 1-5**	**Total score**
1	Proportion of properties off gas grid	0	4	0
2	Proportion of connections on Council owned land (social housing, public buildings etc)	1	3	3
3	Proximity of social housing to anchor load	4	4	16
4	Level of demand from anchor loads (likely scale of demand from building type)			
	Anchor load 1 – Bishop Hedley Catholic High School	5	3	15
	Anchor load 2 – Gwaunfarren Primary School	3	3	9
	Anchor load 3 - Penydarren Social Club	1	3	3
	Anchor load 4 –			
5	Suitable physical location for EC	9	3	27
	Council ownership or influenced area	6	4	24
6	Proportion of pipe runs that will be soft/easy dig	6	4	24
7	Proportion of anchor loads under Council control (%)	6	4	24
8	Usefulness of anchor load diversity and demand (demand during night or middle of the day	5	4	20
9	Dominant level of fuel poverty in the network area (23.85%)	2.4	3	7.2
10	Assets – (potential waste heat connections)	0	2	0
11	Cost escalators (major roads, rail, water courses, gas main, HV to be crossed)	0	5	0
12	Ability for network to serve additional connections	4	3	12
13	Average energy demand density for network area – non anchor load (2190.03 MWh/yr)	9	3	27
	Total area score			**211.2**

	Area number 4 - Cyfarthfa High School	**Score 1-9**	**Weighting 1-5**	**Total score**
1	Proportion of properties off gas grid	0	4	0

2	Proportion of connections on Council owned land (social housing, public buildings etc)	1	3	3
3	Proximity of social housing to anchor load	3	4	12
4	Level of demand from anchor loads (likely scale of demand from building type)			
	Anchor load 1 – Cyfarthfa High School	5	3	15
	Anchor load 2 – Ysgol Gymraeg Santes Tudful	3	3	9
	Anchor load 3 -			
	Anchor load 4 –			
5	Suitable physical location for EC	7	3	21
	Council ownership or influenced area	6	4	24
6	Proportion of pipe runs that will be soft/easy dig	4	4	16
7	Proportion of anchor loads under Council control (%)	9	4	36
8	Usefulness of anchor load diversity and demand (demand during night or middle of the day	3	4	12
9	Average level of fuel poverty in the network area (27.41%)	2.7	3	8.1
10	Assets – (potential waste heat connections)	0	2	
11	Cost escalators (major roads, rail, water courses, gas main, HV to be crossed)	0	5	
12	Ability for network to serve additional connections	0	3	
13	Average energy demand density for network area – non anchor load (1789.98 MWh/yr)	7	3	21
	Total are score			**154.1**

	Area number 5 – High Street	Score 1-9	Weighting 1-5	Total score
1	Proportion of properties off gas grid	0	4	0
2	Proportion of connections on Council owned land (social housing, public buildings etc)	0	3	0
3	Proximity of social housing to anchor load	1	4	4
4	Level of demand from anchor loads (likely scale of demand from building type)			
	Anchor load 1 – Tesco	4	3	12
	Anchor load 2 – Merthyr Tydfil Magistrates Court	4	3	12
	Anchor load 3 - Merthyr Tydfil Central Library	4	3	12
	Anchor load 4 – The LoadLok Community Stadium	2	3	6
5	Suitable physical location for EC	2	3	6
	Council ownership or influenced area	3	4	12
6	Proportion of pipe runs that will be soft/easy dig	2	4	8
7	Proportion of anchor loads under Council control (%)	4	4	16
8	Usefulness of anchor load diversity and demand (demand during night or middle of the day	2	4	8
9	Dominant level of fuel poverty in the network area	2.8	3	8.4

	(27.54%)			
10	Assets – (potential waste heat connections)	0	2	
11	Cost escalators (major roads, rail, water courses, gas main, HV to be crossed)	-3	5	-15
12	Ability for network to serve additional connections	1	3	3
13	Average energy demand density for network area – non anchor load (1915.85 MWh/yr)	8	3	24
	Total area score			**116.4**

	Area number 6 – Caedraw Road	Score 1-9	Weighting 1-5	Total score
1	Proportion of properties off gas grid	0	4	0
2	Proportion of connections on Council owned land (social housing, public buildings etc)	1	3	4
3	Proximity of social housing to anchor load	9	4	36
4	Level of demand from anchor loads (likely scale of demand from building type)			
	Anchor load 1 – Caedraw Primary School	4	3	12
	Anchor load 2 – The College Merthyr Tydfil	5	3	15
	Anchor load 3 -	0	3	0
	Anchor load 4 –	0	3	0
5	Suitable physical location for EC	6	3	18
	Council ownership or influenced area	6	4	24
6	Proportion of pipe runs that will be soft/easy dig	7	4	28
7	Proportion of anchor loads under Council control (%)	9	4	36
8	Usefulness of anchor load diversity and demand (demand during night or middle of the day	3	4	12
9	Dominant level of fuel poverty in the network area (31.94%)	3.2	3	9.6
10	Assets – (potential waste heat connections)	0	2	0
11	Cost escalators (major roads, rail, water courses, gas main, HV to be crossed)	0	5	0
12	Ability for network to serve additional connections	2	3	6
13	Average energy demand density for network area – non anchor load (1966.33 MWh/yr)	8	3	24
	Total area score			**220.6**

	Area number 7 – Hoover/Dragonparc	Score 1-9	Weighting 1-5	Total score
1	Proportion of properties off gas grid	0	4	0
2	Proportion of connections on Council owned land (social housing, public buildings etc)	1	3	3

3	Proximity of social housing to anchor load	2	4	8
4	Level of demand from anchor loads (likely scale of demand from building type)			
	Anchor load 1 – Kasai Factory	4	3	12
	Anchor load 2 – Merthyr Tydfil Institute for the Blind	4	3	12
	Anchor load 3 - Amnitec	4	3	12
	Anchor load 4 – Greenhill Manor Care Home - Hallmark Care Homes	7	3	21
	Anchor load 5 – Merthyr Tydfil County Borough Council offices	3	3	9
5	Suitable physical location for EC	9	3	27
	Council ownership or influenced area	6	4	24
6	Proportion of pipe runs that will be soft/easy dig	7	4	28
7	Proportion of anchor loads under Council control (%)	2	4	8
8	Usefulness of anchor load diversity and demand (demand during night or middle of the day	3	4	12
9	Dominant level of fuel poverty in the network area (27.13%)	2.7	3	8.1
10	Assets – (potential waste heat connections)	0	2	0
11	Cost escalators (major roads, rail, water courses, gas main, HV to be crossed)	-8	5	40
12	Ability for network to serve additional connections	7	3	21
13	Average energy demand density for network area – non anchor load (1983.42 MWh/yr)	8	3	24
	Total area score			186.1

	Area number 8 – Merthyr Road	**Score 1-9**	**Weighting 1-5**	**Total score**
1	Proportion of properties off gas grid	0	4	0
2	Proportion of connections on Council owned land (social housing, public buildings etc)	1	3	3
3	Proximity of social housing to anchor load	3	4	12
4	Level of demand from anchor loads (likely scale of demand from building type)			
	Anchor load 1 – Linde Industrial Park	5	3	0
	Anchor load 2 –			
	Anchor load 3 -			
	Anchor load 4 –			
5	Suitable physical location for EC	9	3	27
	Council ownership or influenced area	5	4	20
6	Proportion of pipe runs that will be soft/easy dig	7	4	28
7	Proportion of anchor loads under Council control (26.73%)	2.7	4	10.8

8	Usefulness of anchor load diversity and demand (demand during night or middle of the day	5	4	20
9	Dominant level of fuel poverty in the network area	2	3	6
10	Assets – (potential waste heat connections)	0	2	0
11	Cost escalators (major roads, rail, water courses, gas main, HV to be crossed)	0	5	0
12	Ability for network to serve additional connections	1	3	3
13	Average energy demand density for network area – non anchor load (1767.17 MWh/yr)	7	3	21
	Total area score			165.8

Area name	Score	Ranking
1 - Prince Charles Hospital/Project Heartland	227.8	1
6 – Caedraw Road	220.6	2
3 - Bishop Hedley	211.2	3
2 - Goat Mill Road	196.5	4
7 – Hoover/Dragonparc	186.1	5
8 – Merthyr Road	165.8	6
4 - Cyfarthfa High School	154.1	7
5 – High Street	116.4	8

Appendix B – Assumptions for energy demands of potential development areas

Key modelling assumptions

Domestic Gas price p/kWh	3.6	**Biomass price p/kWh**	4
Domestic Elec price p/kWh	12		
Non-domestic gas price p/kWh	2.7		
Non-domestic electricity price p/kWh	9		
Likely discount rate for investments	10%		

Notional building (new build and retrofit)

Primary fuel	Gas
Floor area	64
Total gas consumption (kWh/yr)	13869.9
Annual CO_2 emissions / tonnes	3944.9
Annual energy use thermal (kWh/yr)	12609
Annual energy use electricity (kWh/yr)	3100
Minimum monthly gas demand (kWh)	346.7475
Maximum monthly gas demand (kWh)	1654.480929
Baseload annual demand (kWh/yr)	4160.97
Peaking (kWh/yr)	8448.03
Peak Electricity demand (kW/yr)	2
Gas costs (p/kWh)	3.6
Electricity cost (p/kWh)	12
Run hours - baseload	1314
Run hours - peaking	210

Network Costs

Heat networks costs - after AECOM 2015[39]			**Bulk schemes**	**Non-bulk schemes**
		Average	**Average**	**Average**
Network capital costs (buried main)	**£/m**	**£ 984**	**£ 1,242**	**£ 468**

39 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/424254/heat_networks.pdf

Heat network capital costs (annual heat demand)	**£/MWh**	**£ 150**	**£ 150**	**£ 150**
Network costs internal main	**£/m**	**£ 169**	**n/a**	**£ 169**
Substations costs	**£/kW**	**£ 32**	**£ 28**	**£ 35**
Domestic HIUs	**£/dwelling**	**£ 1,075**	**n/a**	**£ 1,075**
Heat meter cost	**£/building**	**£ 2,878**	**£ 1,949**	**£ 3,343**
Heat meter cost	**£/dwelling**	**£ 579**	**n/a**	**£ 579**
Thermal store	**£/m³**	**£ 962**	**£ 1,080**	**£ 843**
Thermal store capacity	**m³/MWh**	**0.015**	**0.016**	**0.014**
CHP engine	**£/kW**	**£ 600**		

CHP costs - after Arup[40]	
Gas CHP Capex Variable Cost £/kW	£825
Energy Centre Capex Fix Cost £/MW	£1,500,000
Biomass Boiler Cost £/kW	£250
Gas Boiler Cost £/kW	£66
CHP Maintenance £/kWhe	£0.0105
Boiler Maintenance	3%
Typical boiler efficiency	85%
CHP lifespan (hours) - after EnerG	60,000
Biomass boiler lifespan	120,000

40 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/66176/Renewables_Obligation_consultation_-_review_of_generation_costs_and_deployment_potential.pdf

Appendix C – Detailed methodology for onsite carbon reduction policy

The UK's electricity carbon intensity has been reducing over the last decade. This is due to a variety of reasons such as:

- The dramatic reduction in the amount of coal in the electricity mix
- The rising amount of gas and renewables in the electricity mix
- Increasing reliance on interconnectors to Europe, which has lower grid carbon intensity
- Reducing peak capacity, resulting in less peaking generation being requires, which is often from diesel and gas generation.

While this is positive, it is making it more difficult to reduce emissions on a percentage basis. This is because more generation is required to save the same amount of emissions.

Domestic electricity and gas consumption for a typical UK household give rise to the annual emissions of 3,485 kg of CO_2. This is based on typical annual consumption of 3,100 kWh for electricity and 12,000 kWh for gas, as well as an emission factor of 0.412 kg of CO_2 per kWh for electricity and 0.184 kg of CO_2 per kWh for gas. The source of these values can be found in the assumptions table below.

Therefore, 697 kg of CO_2 must be saved to achieve a 20 percent reduction in emissions, or 349 kg of CO_2 for a reduction of 10 percent. Often the cheapest way to deliver this is with on or off-site solar PV.

Homes in Merthyr Tydfil receive relatively low irradiance compared to other areas at the same latitude in the UK. Due to the houses being in the valley, the sun is obscured when it is rising and setting in the East and West. This reduces total generation by between five and ten percent compared to other areas at the same latitude. Assuming a distribution between SW to S to SE, generation from a 1 kW solar PV system in Merthyr Tydfil could be 840 kWh, based on data from the online tool PVGIS.

It is then possible to calculate what capacity of solar PV is required to meet an emission reduction. Using the electricity emission factor (0.412 kg of CO_2 per kWh), generation from a 1 kW system (840 kWh) and the kg of CO_2 reduction required (715 kg of CO_2), it can be found that 2 kW of solar PV is required to meet 20 percent of total emissions for a typical household.

Variable factor	Amount	Unit	Source
Ofgem typical medium household electrical consumption	3,100	kWh	Table 42: Electricity and heat demands for the three potential development areas scenario tested
Total consumption emission factor for electricity	0.412	kg/kWh	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016
Ofgem typical medium per meter gas consumption	12,000	kWh	Table 42: Electricity and heat demands for the three potential development areas scenario tested
CO_2 emission factor gas	0.184	kg/kWh	https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016

Solar generation per kW south	873	kWh	http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php#
Solar generation per kW south west/ south east	824	kWh	http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php#
Typical Watts per m²	0.156	kW/m²	Assumption is from market research, based on a 250 W 1.6 x 1 m panel.

Glossary

Anaerobic Digestion (AD)	A process in which organic matter broken down by bacteria in the absence of air, produces a gas (methane) and a solid (digestate) product. The by-products, for example biogas, can be used in a furnace, gas engine, turbine or gas-powered vehicles, and digestates can be re-used on farms as a fertiliser.
Biomass	**L**iving matter within an environmental area, for example plant material, vegetation, or agricultural waste used as a fuel or energy source. This is a 'carbon neutral' energy source because CO_2 is absorbed during the life of the crop, which is then released during combustion.
Capacity factor	The "capacity factor" of a particular technology, is an approximate way of estimating how much energy per year a certain installed capacity of generation will produce. The figures used for different capacity factors are based on experience from existing installations. Because capacity factors are in effect just a guide they can cause confusion among non-specialists about the length of time over which a particular technology is generating. For example, a capacity factor of 0.12 or 12% for PV does not mean that a PV system in the UK will only generate electricity for 12% of the year. What it means is that all of the energy generated by the PV system over the course of a year is equivalent to the PV system generating at its full installed capacity for 12% of the year. Similarly, wind power technology has a capacity factor of around 0.25 to 0.3, or 25 to 30%, but a wind turbine will typically be generating electricity for 80% of the time. It will only be generating at full power for a smaller percentage of time, say 10-15%. The rest of the time it is operating, the turbine is generating somewhere between full power and "cut-in", when it first starts to generate. Another example would be a gas boiler or heat pump which may only operate at full capacity for 20% of the year, as no central heating is required in summer or during the night in winter. Renewable energy technologies with low capacity factors are referred to as "intermittent", and this includes wind, PV and hydro. They are intermittent because the wind does not always blow, the sun does not always shine, and so on. Technologies with high capacity factors are referred to as "reliable", and these include biomass CHP, landfill gas and CAD. No energy technology,

	renewable or non-renewable has a 100% capacity factor, as there will always be a certain amount of downtime for maintenance, and for faults.
Capital Expenditure (CAPEX)	Funds used to acquire or upgrade physical assets such as property, industrial buildings or equipment.
Community energy	Any sustainable energy project that is led by, initiated by or has heavy involvement and benefit to the local community that is hosting it.
District Heating Network (DHN)	A system where a centralised heat generating plant (using any one of a range of technologies) provides heat to surrounding buildings in the area by means of a network of pipes.
Energy from Waste (EfW)	The conversion of waste into a useable form of energy, often heat or electricity.
Feed in Tariff (FIT)	A scheme to incentivise renewable electricity installations (currently) up to a maximum capacity of 5 MW through a revenue payment.
Ground source heat pump (GSHP)	A heat pump technology using stored thermal energy in the ground to heat or cool a building.
Hydroelectricity	A technology generating electricity from running water, usually a small stream. Small or "micro" hydroelectricity systems can produce enough electricity for lighting and electrical appliances in an average home. Hydroelectricity systems are also called hydropower systems or just hydro systems.
Installed capacity	The maximum rated output of an energy installation (electricity or heat) under specific conditions designated by the manufacturer e.g. a solar PV system with an installed capacity of 4 kW can produce a maximum of 4 kWh at any moment if the conditions are perfect. Installed capacity is commonly expressed in kilowatts (kW) or megawatts (MW) depending on the scale of an installation.
kW, MW, GW **kWe, MWe, GWe** **kWth, MWth, GWth**	A kilowatt (kW), megawatt (MW) or gigawatt (GW) is a common unit of installed capacity which is a measure of large a power or heat plant is. Where kWe, MWe or GWe is written this refers to electrical plant. Where kWth, MWth or GWth is written it refers to heat producing plant.
kWh, MWh, GWh	A kilowatt-hour (kWh), megawatt-hour (MWh) or gigawatt-hour (GWh) is acommon unit of electricity generation. It represents how much electricity is produced or consumed over some time period such as a day or a year.

Landfill gas	The gas generated in any landfill site accepting biodegradable material. It consists of a mixture of gases, mainly methane and carbon dioxide. The gas can be used to drive a turbine to generate electricity.
Microgeneration	This refers to the use of onsite technologies to generate heat and/or electricity from low or zero carbon sources.
Off gas areas	Refers to areas of buildings which are not on the mains gas network.
Operational Expenditure (OPEX)	Ongoing costs to run the project, business or system.
Renewable Heat Incentive (RHI)	The non-domestic and domestic RHI provide revenue payments for renewable heat production to incentivise the take up of renewable heat.
Renewables Obligation (RO)	The Renewables Obligation (RO) is the main current financial support scheme for renewable electricity in the UK, and is administered by Ofgem. It obliges electricity suppliers in the UK to source a proportion of their electricity from renewable supplies. They demonstrate this has been achieved by showing they have the required quantity of Renewable Obligation Certificates (ROCs), which renewable electricity generators are awarded for their output. The Renewables Obligation will be replaced by Contracts for Difference (CfDs) from 2017.
Solar photovoltaics (PV)	A renewable system converting sunlight into electricity, which can be used to power (or partially power) electrical equipment and appliances.